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EVALUATION OF FOUR COMPLETED SMALL WATERSHED PROJECTS:

SOUTH CAROLINA,
MARYLAND,
IDAHO—NEVADA,
AND WEST VIRGINIA

U.S. DEPARTMENT OF AGRICULTURE
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EVALUATION OF FOUR COMPLETED SMALL WATERSHED PROJECTS: SOUTH CAROLINA, MARYLAND, IDAHO-NEVADA, AND WEST VIRGINIA. By John D. Sutton. Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 271.

ABSTRACT

This study was designed to determine the efficacy of the planning process and in four operating small watershed projects. A qualitative appraisal was made of actual performance and costs, which were then compared with work plan projections. Particular attention was paid to factors, as reported by project beneficiaries and leaders of local sponsoring organizations, that affected the size and composition of these realized values.

The desired physical manipulation of the water resource--reducing flooding, improving drainage, and providing water for irrigation, municipal use, and recreation--was achieved in each project. However, this was not always equivalent to generating desired economic performance; for example, higher crop yields. Thus, realized values often differed in size and always in composition from projected values.

Study results indicate that planners should strongly encourage local involvement in planning, evaluate social and economic variables that tend to delimit a project's operating environment, and use a multiobjective planning approach to minimize differences between work plan estimates and actual values. The projects evaluated reportedly had only a limited impact on the natural environment.

Key Words: Water resources, economic evaluation, planning, public participation, environmental impact

PREFACE

The U.S. Department of Agriculture's Small Watershed Program provides Federal technical and financial aid to local organizations to develop projects for control of flooding, erosion, and sedimentation; agricultural water management; recreation; fish and wildlife development; and municipal and industrial water supply. The program applies only to watersheds no larger than 250,000 acres, and is administered by the Soil Conservation Service under Public Law 83-566.

This study is one of a series on the Small Watershed Program. An ex post evaluation of four projects was undertaken to study the efficacy of the planning process. Projected levels of benefits and costs were compared with actual performance, and possible reasons for differences were identified and evaluated. Work plan files, personal interviews with project residents and sponsors, and Censuses of Agriculture and Population were the main sources of information. The findings in this study should not be generalized to the entire Small Watershed Program or to all land and water resource projects.

Photos courtesy of Soil Conservation Service

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SUMMARY

Many factors other than a watershed project's management of the water resource affect landowners' decisionmaking. These factors are significant because they reflect the socioeconomic environment within which the projects must function. Planners need to be cognizant of them in estimating future impacts.

The Small Watershed Program is a Federal, State, and local cooperative program designed to prevent erosion, floodwater, and sediment damage and to improve the conservation, development, utilization, and disposal of water. The program applies to watersheds of 250,000 acres or less. Four completed watershed projects were evaluated in this study in an effort to identify factors that may affect a project's actual performance, which often varies in magnitude and usually in composition from work plan estimates.

In each of the four watershed studies, water management was expressed by local sponsors as the primary purpose of project installation. The ex post evaluation showed that performance was:

- (1) Nearly the same as work plan projections for (a) improved drainage; (b) irrigation water management; and (c) urban flood damage reduction, provided there has been relatively little intensification in land use.
- (2) Greater than projected for (a) municipal/industrial water supply; and (b) urban flood damage reduction in areas given protection from the 100-year flood event if land use has since intensified.
- (3) Less than projected for (a) agricultural damage reduction; (b) agricultural flood damage reduction based on a restoration of the flood plain to former levels of productivity or by intensified land use; (c) incidental recreation; and (d) urban flood damage reduction in areas given protection from only the 3-year flood event if land use has since substantially intensified.

The composition of current benefits differs substantially from those projected because of unexpected changes in land use. For example, estimated benefits from improved drainage and irrigation water supply were based on continued production of the major crops in the watershed areas. Each crop made a specific contribution to this flow of benefits. Hence, changes in the acres cultivated of each crop since project installation have consequently affected performance.

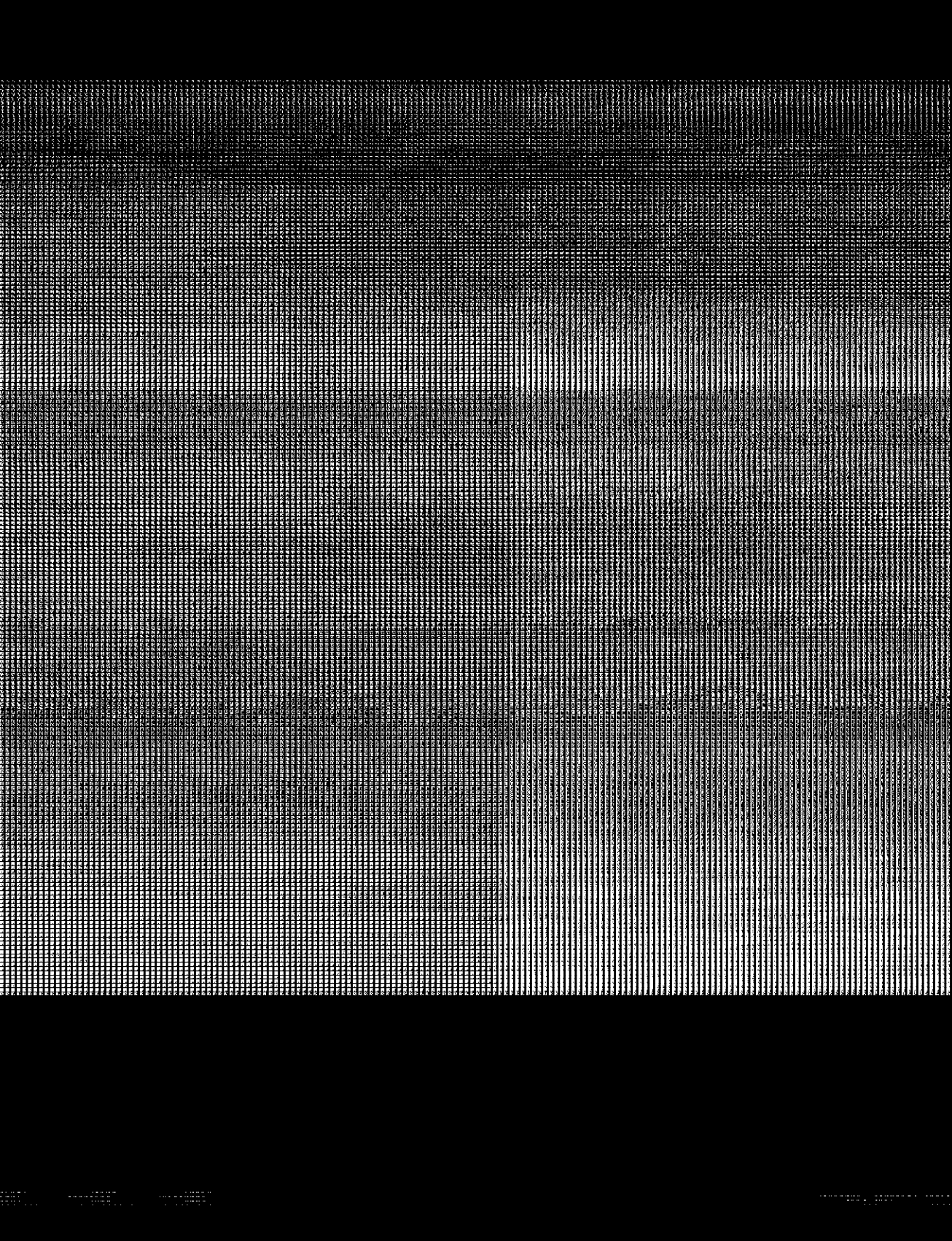
Costs associated with operation and maintenance of structural measures have been below work plan estimates for each project. In two projects, all work essential to proper project operation has been done. In the remaining two, maintenance has been inadequate, reportedly for lack of funds.

Achieving the projected levels of benefits and costs was found to be related to a variety of factors. In some cases, these factors appeared to be as important as the water resource development.

Accurate interpretation of local needs and translation of them into project design appeared to be very important. In the projects where planning emphasis was placed on a "need" not clearly defined, such as flood protection to agricultural bottom lands, the expected changes have not occurred. Conversely, if a major need was identified, such as municipal water supply, projections were realized.

A closely related element is local involvement during project planning. Vigorous and widespread interest was evident in the two most successful projects. In both watersheds, interviewed residents could not identify any single individual as "especially influential" in planning; and the local sponsors paid a major share of construction costs. In the two less successful projects, one person was identified as "especially influential"; and local cost-sharing was much less.

Social and economic changes discernible in the project's parent county or multicounty area were found to be consistent with information gathered in each watershed. Explicit consideration of socioeconomic trends appeared quite influential to generating projected values. For example, expected watershed land use changes did not occur in the face of opposite trends in the parent area. Landowners' installation of on-farm capital investments in response to their project appeared closely related to the health of the economy in the parent area.



²⁰⁰¹ **EVALUATION OF FOUR COMPLETED SMALL WATERSHED PROJECTS:**

**SOUTH CAROLINA, MARYLAND,
IDAHO-NEVADA, AND WEST VIRGINIA**

by
²⁵⁰¹
John D. Sutton*

INTRODUCTION

Small Watershed Program

The Watershed Protection and Flood Prevention Act of 1954 (P.L. 83-566) authorizes the Soil Conservation Service (SCS), U.S. Department of Agriculture, to cooperate with State and local agencies to prevent erosion, floodwater, and sediment damages and to improve the conservation, development, utilization, and disposal of water and thereby preserve and protect the Nation's land and water resources. This Small Watershed Program applies to watersheds of 250,000 acres or less.

On receipt of a State-approved application from a local sponsoring organization, SCS may provide technical assistance to the sponsors in developing a watershed work plan. Once the work plan is approved, either by the appropriate committees of Congress, or in some cases administratively, the Federal Government will share the cost of implementing the project's structural and land treatment measures. As of January 1, 1974, 1,682 project work plans had been authorized for planning assistance and 1,084 had been approved for operation.

Planners are charged with formulating projects that satisfy several economic criteria; one is that "tangible benefits exceed project economic costs." ^{1/} This criterion is normally expressed in a benefit-cost ratio that must be greater than 1 to 1 if a project is to be approved for Federal cost sharing. Meeting it is beset with uncertainty, since most costs and all benefits do not begin to accrue until several years after planning. In order to best deal with the uncertainties of planning, SCS has developed a consistent set of procedures that combine technical expertise and local input.

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^{1/} Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water Related Land Resources, Senate Doc. No. 97, U.S. Govt. Print. Off., Wash., D.C., 1962.

To calculate the benefits properly attributable to a proposed project, the planner estimates the economic differences between two situations: the future without the project and the future with the project. The costs and effects of nonproject investments should be excluded from these calculations. In the case of a project whose purpose is to reduce flood damages to cropland, benefit calculation would entail estimating project-induced changes, if any, in cropping patterns, crop yields, prices, and production costs. He would also specify the costs of all project structures and of associated on-farm investments, and the annual cost of operating and maintaining each. A myriad of factors influence these estimates and hence expected benefits and costs. For example, expected crop yield and cost changes are related to the intensity of flooding and the time during the growing season that flooding occurs. In addition, the project's net effect on these yield and cost changes may assume landowner responses to the reduction in flood hazard. This may entail shifting to a higher crop production level and/or making on-farm investments in drainage, land clearing, and leveling.

Study Purpose

The purpose of this study was to determine the efficacy of SCS planning procedures used in four projects. By means of interviews, a qualitative appraisal was made of current values of primary benefits and costs generated by structural measures. These values were then compared with the average annual values estimated in the work plan. ^{2/} It is recognized that values may change from year to year; and generalizations for the entire Small Watershed Program cannot be drawn from these four case studies.

Land treatment measures were not specifically evaluated in the study. However, if the work plan stated that installation was essential, the measures were discussed herein. Actual costs include annual operation and maintenance expenditures for the structures. Structural installation costs, on the other hand, were not analyzed as they were considered spent during and immediately after construction.

Particular attention was paid to the factors, as reported by project beneficiaries and local sponsors, that were instrumental in determining the size and

^{2/} Previous researchers have attempted to measure quantitatively the actual project impacts for direct comparison with the work plan benefit-cost ratio. For example, seven pilot watershed projects were evaluated to determine their physical and economic effects. The emphasis was strongly quantitative, with data collected from field interviews and instrumentation for periods up to 10 years after project completion.

In the Six Mile Creek evaluation, a representative study, 4 years of pre-project and 9 years of postproject data were collected. Although considerable effort was put into the study, the evaluation was only partly successful. The researchers fairly assessed the study techniques used, and recognized several weaknesses. They concluded that much more information was needed on factors exogenous to planning. Since this was not obtained, no significant cause-effect relationships could be determined.

composition of actual benefits and costs. The analysis of each project was not an end in itself but rather a means of evaluating the ability of project planners to achieve stated objectives of the Small Watershed Program.

Project Selection

Selection of projects for this study was based on the following criteria:

(1) Need for one or more of the major watershed program purposes. These are flood damage reduction (damage reduction to crops and pasture is the most important component); recreation; drainage; intensified land use; irrigation; and municipal/industrial water supply.

(2) Work plan approval between 1960 and 1965, to avoid projects planned in the early and possibly still formative years of the program.

(3) Structures completed between 1966 and 1969, to allow time for structural effects to be felt but to minimize the respondents' problem of recalling preconstruction conditions.

Four projects were chosen that would provide variations in planning and performance associated with (a) single and multiple objective projects; and (b) each major program purpose. The projects selected, locations, their purposes, dates of approval, and dates of construction completion are listed below:

(1) Big Creek, Anderson County, South Carolina. Urban and agricultural flood damage reduction, intensified land use, incidental recreation, municipal/industrial water supply; approved June 1963; construction completed April 1968.

(2) Coonfoot Branch, Worcester County, Maryland. Drainage and agricultural flood damage reduction; approved June 1964; construction completed May 1968.

(3) Cedar Creek, Twin Falls and Owyhee Counties, Idaho, and Elko County, Nevada. Agricultural water management (irrigation); approved March 1962; construction completed June 1967.

(4) Peck's Run, Upshur and Barbour Counties, West Virginia. Urban and agricultural flood damage reduction; approved July 1963; construction completed June 1968.

Although the four projects studied differ in several respects, such as the problems to be alleviated, location, and economic structure of the surrounding area, they are similar in several ways. The most important similarity is that each project was developed, installed, and now functions as a separate unit in

the Small Watershed Program. In addition, all problems identified related to the conservation, development, utilization, and disposal of a common element--water.

Data Collection

P.L. 566 requires that "full initiative and maximum responsibility for any undertaking be exercised by the local people," ^{3/} and indeed, SCS has continually stressed the importance of active local involvement. Hence, the major data input was from local persons who were expected to benefit from the project or were instrumental in its planning. Data collection proceeded in three steps: (1) The work plan and project files were reviewed to determine which persons gave easements and/or attended planning meetings, how local objectives were articulated during planning, what alternatives were considered, what problems arose before and after installation, and the extent of post-installation maintenance; (2) interview of "residents," that is, persons who resided on and/or operated land parcels that were directly benefited by project structures; and (3) interview of sponsors; i.e., representatives of the local sponsoring groups.

The interviews with residents were designed to determine impacts on land parcels directly benefited by project structures. Hence, respondents were selected who resided on and/or operated such parcels before structural installation (1964 to 1967, depending on the project), and the last crop season preceding the 1972 survey (1971).

For the Cedar Creek project, only 10 persons could be located to interview. For the other three, there were 21-25 interviews per project. The resident questionnaire consisted of three sections. Section A, Personal Information, related to the economic status of the respondent, his opinion regarding the project's effect on watershed incomes, and changes in the area's economy over the past decade. In Section B, Current Appraisal of Benefits and Costs, the respondent was asked how the water-related problem had changed, whether he had made any changes in his farm operations or land use since installation and, if so, the reasons for them; the effect of the project on his personal income; and any other effects it might have had. All purposes were appraised except for municipal water supply, which was covered in the sponsor questionnaire. Section C, Project Planning, related to the respondent's involvement in planning and his opinion on ways the project might have been improved.

The sponsor questionnaire, consisting of five sections, was used for four to six interviews per project. Sections A, B, and C related to municipal water supply, recreation, and irrigation. Section D was designed to evaluate differences between planned and current values and to describe socioeconomic changes in the watershed since planning. Section E was designed to investigate the planning process, including identification of any problems encountered, alternatives considered, and issues of importance to local planners.

^{3/} U.S. Dept. Agr., Soil Conserv. Serv., Watershed Protection Handbook, Pt. 1, Planning and Operations, Section 101.00, 1967.

SURVEY FINDINGS

The desired physical manipulation of the water resource was achieved in all four projects. That is, flooding decreased, drainage improved, and water was provided for irrigation, municipal/industrial use, and recreation. However, this successful manipulation was not always equivalent to generating desired economic effects, for example, raising crop yields. Table 1 indicates that performance sometimes equaled plan projections, and at other times was greater or less than planned. Operation and maintenance costs have been below those estimated for each project.

Table 1--Estimated benefits and actual performance,
four watershed projects

Purpose	Project	Performance compared to estimated benefits
Agricultural flood damage reduction and intensified land use	Big Creek	Smaller
Agricultural flood damage reduction	Peck's Run	Smaller
Improved drainage for agriculture, and agricultural damage reduction	Coonfoot	Same
Irrigation water management	Cedar Creek	Same
Nonagricultural flood damage reduction	Big Creek	Same
Nonagricultural flood damage reduction	Peck's Run	Same (greater; smaller) <u>1/</u>
Municipal/industrial water	Big Creek	Greater
Incidental recreation	Big Creek	Smaller

1/ Greater for the 100-year flood protected area; smaller for the 3-year flood protected area. A 100-year flood is a precipitation event of a specified magnitude or greater that may be expected to occur once in 100 years in a 24-hour period. The 3-year flood can be expected to occur once in 3 years on the average.

In terms of attitudes of the projects' effects on their respective communities, extent of landowner response to structural improvements, and actual performance, the Coonfoot Branch and Cedar Creek projects have shown the most success. The Big Creek and Peck's Run projects have had mixed performances: in some respects they have met or exceeded expectations, while in others they have fallen short.

Study results indicate that in addition to the effect of the watershed project, a variety of social and economic factors influence project impacts. Since they reflect the environment within which projects must function, planners need to be aware of them in estimating future benefits and costs. These factors are discussed below in terms of watershed project planning. Where appropriate, Coonfoot Branch and Cedar Creek are compared with Big Creek and Peck's Run.

Problem Identification

Accurate interpretation and translation of local needs to the designed project were essential to the generation of the expected level of benefits. Cedar Creek and Coonfoot Branch each had one clearly defined problem that was critically affecting the economic livelihood of people in the watershed. For Cedar Creek, it was the prolonged interruption of irrigation water supply; for Coonfoot Branch, it was standing water on cropland following heavy rainfall. In both projects, planners also identified other, but secondary, water-related problems. These problems were given less emphasis throughout planning, and none were evaluated for the benefit-cost ratio.

Problems were less well defined for Big Creek and Peck's Run. For Big Creek, agricultural flood protection, an objective of only minor local importance during project planning, was the basis for the most important work plan purposes. Nonagricultural purposes, e.g., municipal water supply and urban flood protection, became secondary in the work plan. Yet, under project operation, these secondary purposes have produced benefits equal to or greater than estimates, while agricultural benefits have been much below estimates. Similarly, in the Peck's Run project, agricultural flood protection--an objective of uncertain importance to the local people--was the basis for nearly one-fifth of work plan benefits. These benefits have not been realized. Nonagricultural flood protection, on the other hand, was recognized as a serious need. Landowners have been satisfied with the project in this regard, as attested by the installation of several new and remodeled buildings in the protected area.

Agricultural flooding was a problem in both Big Creek and Peck's Run. Although planners in both areas based future benefits on a restoration of flood plain productivity, another enhancement-type benefit--intensification of land use--was also evaluated in Big Creek. The author of this study could not determine the practical distinction between the two types of benefits. It is suggested that SCS consider eliminating this ambiguity by either discontinuing or de-emphasizing one or the other in future projects.

Local Interest

The project purposes for which realized values approximated projections were found to be based on an active involvement of the local people during planning. Vigorous and widespread interest was evident in both Cedar Creek and Coonfoot Branch. In Cedar Creek, ranchers had repeatedly made serious attempts to solve their water supply problem. They initiated the resolution of the major difficulty of sponsorship qualification; and they assumed responsibility for a substantial share of structural construction costs. In Coonfoot Branch the sponsors, at local expense, improved a major section of the channel not allowable in the designed project, and also paid a share of the construction cost; respondents reported that no one local individual was "especially influential in planning"; and farmers have been installing land treatment measures more rapidly than expected. In both projects, the local people have maintained the structural measures as determined necessary.

In Big Creek and Peck's Run, such local interest was not as evident. Two-thirds of the residents interviewed in each project identified just one person as "especially influential in planning"; no local cost-share was paid (or required) for the construction of flood control structures; ^{4/} and installation of land treatment measures was far behind the planned rate. Maintenance of the improved channel and of the recreation component of the (Big Creek) reservoirs has not been carried out as needed.

Two major exceptions to a lack of local interest in these two projects were the municipal water supply and nonagricultural flood prevention in Big Creek. Planning correspondence shows considerable local concern over these two needs; the town employed an engineering firm to determine its future water requirements and it paid all construction costs allocated to water supply. Post-construction evidence of interest includes the park improvement program along the creek channel, and installation of an expanded water distribution system.

Local interest and involvement has been and is the hallmark of the Small Watershed Program. This study identified its value to four projects in terms of generating expected performance and assuring satisfactory postconstruction maintenance. It is recommended that SCS continue to emphasize ways to promote this local input. A suggested means would be data collection by the local sponsors for 2 or more years after they apply for planning assistance. Careful selection of the types of information to be gathered and some limited supervision by SCS would be necessary to assure reliable data.

Some types of data that could be feasibly gathered would include precipitation, high water marks, land use, and crop yields. This source of data would not be the primary basis for design of the final project. Rather, it would (1) complement data the planning party would gather if the project was approved; (2) provide a longer time period of data collection; and again, (3) develop local responsibility (or determine the lack of it) at an early stage in project formulation.

^{4/} In all four projects, the sponsors were responsible for purchasing necessary land and water rights, administering contracts, and operating and maintaining the structural measures.

Socioeconomic Environment

Field interviews in a proposed project area combined with secondary data at the larger county or multicounty level give planners a basis for projecting project impacts. Identifying and taking account of certain social and economic factors may be crucial to the planning task.

In the four projects studied, it did not appear that planners explicitly considered the possible effects that social and economic factors might have on their project's performance. Table 2 compares cropland changes in each watershed and its parent county in both the project planning and operation phases. The "Planning phase" columns show that work plan projections usually (12 of 15 times) were not in the same direction as county trends. However, the "Operations phase" columns show that surveyed changes were most often (10 of 15 times) in the same direction as county trends. The inference to be drawn is not that project planners should always make projections that agree with those at the county level; but, in making those projections, it might be worthwhile to consider trends in a larger area for which secondary data are available.

Projected land use changes in Big Creek and Peck's Run and the expected on-farm land treatment measures in all project areas suggest that the planners considered the respective watershed economies were relatively healthy and would respond to project installation. Again, however, planners apparently did not investigate existing social and economic trends at either the county or watershed level. For example, between 1950 and 1960, the decade preceding planning, census data for each county indicated the decreasing importance of the agricultural economy. Each county, except that for Coonfoot Branch, experienced shifts in population from rural to urban areas, as well as absolute and relative declines in agricultural employment. Between 1954 and 1959, all four counties experienced increasing off-farm employment of farmers and fewer farms.

The 1972 survey and census data for 1964 and 1969 indicate that changes in the economy of each watershed were consonant with changes in the larger area. Persons interviewed were asked to describe changes in the watershed economy during the 1960's, and the factors that fostered or hindered changes in land use and more intensive use of inputs. Half of the 70 respondents said that farming as a source of community income had become less important in their area since the early 1960's; 28 said there had been no change; 7 reported that farming was more important. Costly inputs, especially labor, were a major barrier to earning a good living from farming. Retirement age, poor health, and off-farm employment were also frequently cited as factors that impeded expected responses to the project.

This local information was supported by county-level census data for 1964 and 1969, the period roughly corresponding to project operation. The declining trends in rural population, agricultural employment, and farm numbers identified in 1954 and 1959 continued. Both the Big Creek and Peck's Run counties recorded a drop in farm product sales (in constant terms) between 1964 and 1969; the other two project counties reported increases, but only of some 2 percent.

Table 2--Land use changes during planning and operation phases,
four watershed projects

Project and land use	Direction of change			
	Planning phase		Operations phase	
	Work plan estimates	Census, 1954-59 <u>1/</u>	1972 survey	Census 1964-69 <u>1/</u>
Big Creek				
Corn	+	-	-	-
Pasture	+	-	+	+
Peck's Run				
Corn	+	-	-	+
Hay	+	-	-	-
Pasture	-	-	<u>2/</u>	+
Coonfoot Branch				
Corn	<u>2/</u>	-	+	+
Soybeans	<u>2/</u>	+	-	-
Small grains	<u>2/</u>	-	-	-
Pasture	<u>2/</u>	-	-	+
Cedar Creek				
Alfalfa hay	<u>2/</u>	-	+	-
Alfalfa seed	<u>2/</u>	-	-	-
Dry beans	<u>2/</u>	-	+	<u>3/</u>
Wheat	<u>2/</u>	<u>2/</u>	-	-
Mixed grains	<u>2/</u>	<u>2/</u>	+	+
Potatoes	<u>2/</u>	-	-	-

1/ Census data are for each project's primary county only.

2/ No change.

3/ Data not available.

Local Response to Structural Improvements

Land use changes varied by project and by purpose. Little or no land use change was estimated for urban flood damage reduction, municipal water supply, or recreation. However, as discussed earlier, some land use changes were made. In one case--urban flood damage reduction--it appears that intensified flood plain use may have brought about a reduction in expected net benefits.

The major changes in land use were expected in response to agricultural flood damage reduction, but response varied depending on the projects. In Big Creek and Peck's Run projects, costly land use changes would have been required to achieve estimated benefits, but these changes have not been forthcoming. Similarly, the installation of land treatment measures has lagged far behind expectations.

In contrast, land use adjustments were not necessary in the more successful Coonfoot Branch and Cedar Creek projects. Expected land treatment measures were directly related to improved agricultural output--the landowners' major source of income. ^{5/} In both projects, installation of land treatment has been as rapid or more rapid than expected. It is important to note, however, that most of the benefits could be realized with only a limited response from landowners. Operators traditionally made their annual farm plans hoping the problem, whether it was a break in the supply of irrigation water (Cedar Creek) or prolonged rainfall (Coonfoot Branch), would not occur that year. In Cedar Creek, the acreage and crops selected for cultivation each year were based largely on water supply forecasts. Coonfoot Branch farmers tried to cultivate both their well-drained and their poorly drained land each year. Even before the project, they minimized standing water problems as much as possible by installing drainage ditches and leveling their land.

Planners should be aware of social and economic factors that could inhibit responses to structural measures. The planning party should continue to make concerted effort toward identifying these factors in the Preliminary Investigation, an early stage in the planning process. As planning processes and information on these factors improve, planners could decide (1) what weight to place on local responses in estimating benefits, and (2) what types of local response would be the most probable.

For example, landowners in a declining agricultural area, such as the lower reaches of Big Creek, are less likely to make land use changes or install needed on-farm investments 5 to 10 years after planning than are landowners in an agriculturally stable or expanding area. In the Big Creek area, the cost of clearing woods for improved pasture was probably prohibitive, especially since the timber was not marketable. Landowners earning most of their income from nonfarm jobs would have little incentive to incur farm improvement costs in order to gain an uncertain income from farm product sales or land rental. Under these circumstances, planners might decide to place little reliance on local response in estimating benefits.

Planning Interviews

The SCS watershed planning party carried out field interviews for each project. However, the use or extent of the data gathered was not clear, since the forms were often incomplete. Also, the types of data gathered in the project area

^{5/} The 1972 survey recorded land use changes, but few were due to the project.

did not alone provide an adequate basis for calculating benefits. It can be assumed that information and experience with water resource problems in other watersheds were drawn upon to aid in these calculations.

Since the 1958 Cedar Creek survey forms did not ask operators to estimate yield damage from an interruption in the water supply, they could not be used to document the procedure for calculating the reduction in damages; yet, this was the economic basis for the project. Similarly, in Coonfoot, the schedules were not designed to determine how much the crop yields would improve with adequate drainage. The average preproject yields reported for corn and soybeans were substantially above the base levels used in the work plan to calculate benefits; no yields were recorded for small grains or pasture, although these two land uses were also projected. In Big Creek, the agricultural damage schedules were very incomplete, and did not provide planners with any useful information on present or future land use, yields, or damages. In Peck's Run, nonagricultural flood damage was well recorded. Unfortunately, the questionnaires did not provide a sound basis for estimating agricultural damage reduction benefits.

Except for the Coonfoot project, the questionnaires were not designed to determine how landowners would respond to the structural improvements. None of them recorded socioeconomic data or identified water or nonwater-related problems that might inhibit landowners from making the responses necessary to generate benefits. The need for socioeconomic data to assist in estimating project benefits and costs, and the factors fostering and/or hindering landowner response to structural measures, are first addressed by project planners during the Preliminary Investigation. Although substantial progress has been made in this approach since the four studies were formulated, a further modification to develop the watershed socioeconomic profile is suggested. This would involve:

- (1) Broadening the scope of the field interviews to gather data on demographic changes, changes in and importance of agricultural and nonagricultural activities in the watershed area, landowners' opinions on the underlying reasons for these local changes, sources and uses of water, and identification of water-related problems.

- (2) Complementing this watershed-level information with that already collected by the local people, and with county-level trend information derived from the Censuses of Agriculture and of Population, other relevant publications, and professional persons knowledgeable of the area.

Once the physical coefficients of the draft project are determined, the economist could utilize limited sensitivity testing to allow more adequate analysis of uncertainty. This analysis would consist of giving alternative values to key variables in order to evaluate their impact on the benefit-cost ratio. As a modest but important extension of this testing, the economist might discuss the probabilities of each key variable meeting the alternative

values selected. This would be especially important in those projects where specific responses from area landowners would be essential to realizing benefits.

Operation and Maintenance

In each of the four projects, average annual operation and maintenance (O&M) costs have been below work plan estimates. In two cases, all necessary work was being done. In the other two projects, either no work was needed, or work was needed but not provided. Regardless of the validity of the reasons cited for not providing O&M (insufficient funds was cited in the latter two projects), improper maintenance may reduce future project benefits.

Unevaluated Effects

The survey identified one or more primary effects in each project that could have been but were not evaluated for the work plan benefit-cost ratio. Favorable effects mentioned by respondents included flood damage reduction to domestic water springs, irrigation pumps, and county roads; additional tillable land from straightening channels and drainage ditches; newly harvestable woodlands provided by lowering the water table and thus improving access for heavy machinery; and more efficient and flexible use of water allotment. Higher land values were cited in each area as a project-induced effect, although the land market response was only a reflection of primary benefits.

Environmental Effects

The majority of the persons interviewed in each of the four areas said the project had no effect on the environment (table 3). The specific factor most often considered enhanced was the beauty of the area. When an effect was mentioned, it was more often favorable than unfavorable. All of the negative responses for hunting, fishing, and wildlife cover, and six of seven for beauty were reported in Big Creek and Peck's Run, where natural systems received channel improvement. Nearly all of the negative responses came from persons residing along the channeled stream reaches.

Easements

Except for Coonfoot Branch, obtaining easements was a serious hindrance to implementing the work plan. ^{6/} In Peck's Run, after most of the easements had been donated, the sponsors purchased several easements rather than use the power of eminent domain. In Big Creek, several persons said the land taken did not appear to correspond with the area they intended to give by easement. In both projects, residents reported that the language of the document itself was not readily understandable. Actual easement costs exceeded the estimated amounts, and ill feelings continue toward this aspect of the projects. In Cedar Creek, condemnation proceedings had to be started

^{6/} The Uniform Relocation Assistance and Real Property Acquisitions Policies Act of 1970 now provides reimbursement (cost-shared) to residents forced to relocate because of project installation. Local authorities are responsible for obtaining easements.

to secure the right-of-way for a diversion dam constructed in the upper watershed. Although the procurement of land and water rights is entirely a local responsibility, watershed residents often related the project and its associated problems to the SCS.

Table 3--Environmental impact of four watershed projects 1/

Environmental factor	Respondents' opinions of project impact			
	Helped	No effect	Hurt	Total
		<u>Number</u>		
Hunting	13	54	7	74
Fishing	18	49	7	74
Wildlife cover	22	44	8	74
Soil erosion	26	41	7	74
Water quality	28	44	2	74
Risk of brush fire	12	62	0	74
Beauty	48	19	7	74

1/ Coonfoot Branch--19 responses; Big Creek--23 responses; Peck's Run--22 responses; Cedar Creek--10 responses.

EVALUATION OF PROJECTED AND ACTUAL PERFORMANCE

The analysis of each of the four projects studied consists of two major sections. The first qualitatively compares work plan estimates with actual performance. The second section discusses reasons for differences between the two. Particular attention is paid to local objectives and interest, data collected by planners, socioeconomic trends in the watershed and the county or counties involved, and operation and maintenance of the project. The first section is based entirely on the survey data; the second is supplemented by information from planning files, and from the U.S. Censuses of Agriculture and of Population.

Big Creek Watershed Project

The Big Creek project area is a 13,279-acre subwatershed of the Saluda River (fig. 1). It is located in the rural piedmont of western South Carolina, midway between two of the State's principal business centers, Anderson and Greenville. Economic activity at the time of project formulation was predominantly agricultural.

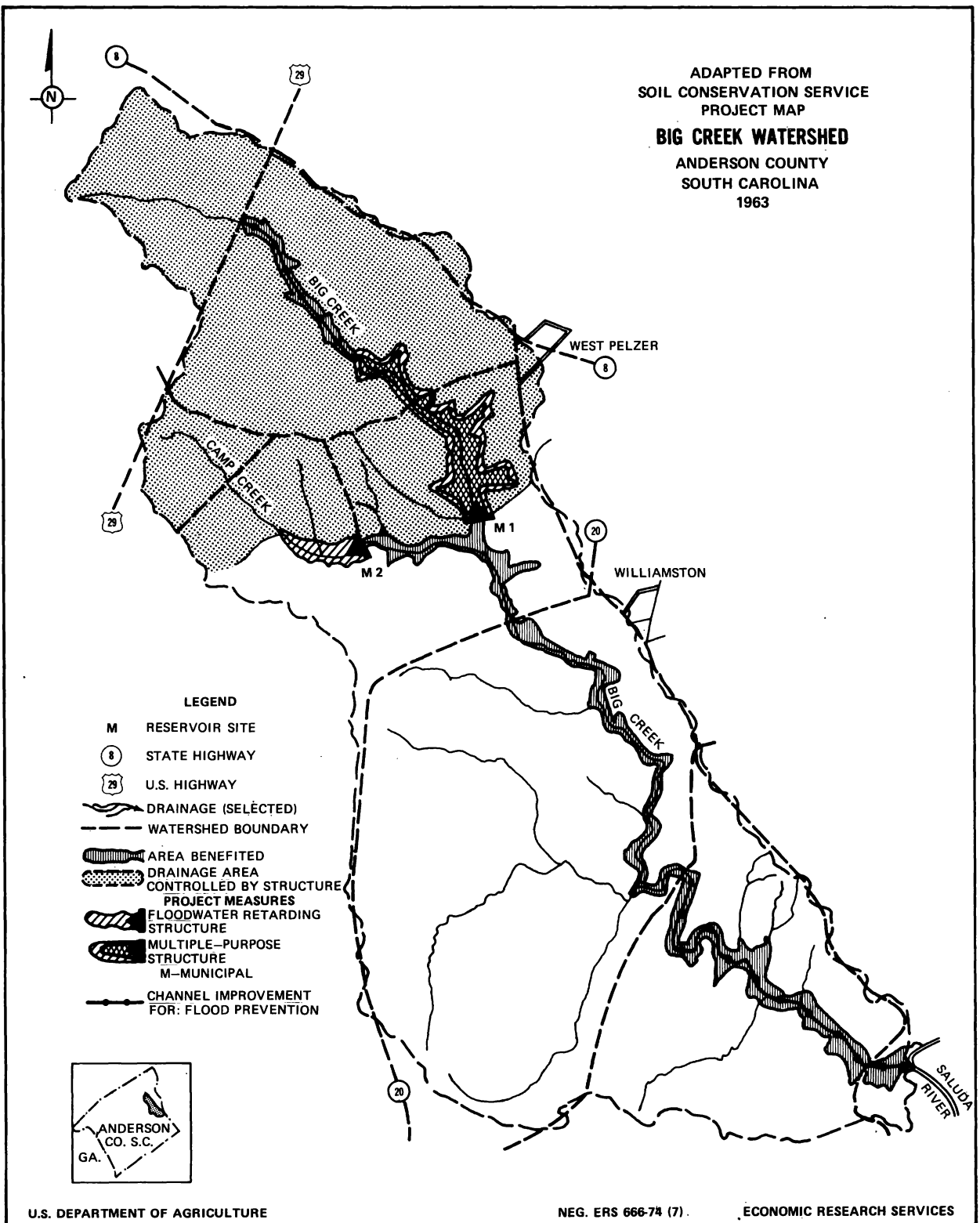


Figure 1

The Big Creek watershed had several problems for which P.L. 566 assistance was requested. The work plan reported that, because of annual flooding, only 21 percent of the flood plain was in agricultural use. Flooding also damaged nonagricultural improvements, especially the park and the water filter plant in the town of Williamston (1960 population, 3,700). In addition, the town's water supply, provided by Big Creek, was becoming increasingly inadequate, especially in dry summer months.

A project was developed and approved (1963) that included one single-purpose floodwater-retarding structure, one multipurpose structure, a water pipeline from the latter to the existing water filter plant, and 23,000 linear feet of channel improvement. The work plan was amended in 1965 to add municipal water storage to the single-purpose structure. Protection of agricultural bottom lands from the 3-year flood event was expected to bring about increased agricultural production. ^{7/} Protection of Williamston from the 100-year flood event would reduce urban flood damages. The multipurpose structures would provide water storage for the town's present and future needs, as well as water-based recreational opportunities. The project was completed in June 1968.

Projected and Actual Performance

Agricultural Flood Damage Reduction--At the time of the survey (1972), 5 years after project installation, it was evident that project performance was below the average annual estimates of the work plan. It had been expected that farmers, in response to reduced flooding, would restore their bottom lands to former productivity and would intensify existing land use. These changes on the agricultural flood plain were to account for 39 percent of estimated benefits. They would be expressed in two ways: (1) changes in flood plain use, and (2) increased pasture yields.

Flood plain use was expected to change within 5 years after structural installation to include an additional 104 acres of improved pasture and 101 acres of corn (table 4); no corn was grown before project installation. To offset these changes, woodland was expected to contract 205 acres. A total 317 acres of flood plain would need to be in cultivation to meet the projected work plan benefits. This would consist of 112 acres of pasture existing before the project, an additional 104 acres of improved pasture, and 101 new acres of corn.

The field survey covered only 265 acres of flood plain (and 2,287 acres of contiguous upland), whereas the work plan evaluated a 519-acre flood plain. Because this surveyed area also is nearest the stream channel, it is provided with the least degree of flood protection. The size difference lies in flood plain definitions used in the survey. Respondents were asked to identify the

^{7/} A 3-year flood is a precipitation event of a specified magnitude or greater that may be expected to occur an average of once in 3 years over a 24-hour period. The 100-year flood has a chance of occurring once in a 100 years.

land that historically flooded once or twice yearly; project planners, on the other hand, used the hydrologically defined 100-year flood plain--a much larger area. Because of this difference in flood plain definitions, this study also considered land use changes reported by respondents for their lands (uplands) adjacent to the flood plain.

The 1972 survey indicated that expected flood plain land use changes had not taken place. Corn acreage contracted rather than expanded (first four columns of tables 4 and 5); pasture acreage expanded but much less than expected. Pasture acreage in the flood plain was expected to expand 93 percent (104 acres + 112 acres = 93 percent); it actually expanded 21 percent (17 acres + 80 acres = 21 percent). These results are consistent with the surveyed upland changes (last two columns of tables 4 and 5).

Ten respondents reported changes in land use between 1966, the year preceding project installation, and 1971. However, only two considered the project an important reason for the change.

The second way in which agricultural benefits were to be expressed was a tripling of flood plain pasture yields from 3 to 9 AUM. ^{8/} Projected benefits and observed performance could not be adequately compared because respondents could not separate bottom land from upland yields. However, the survey indicated a 52-percent increase, from 4.2 AUM to 6.4 AUM, in the combined flood plain-upland area (table 6). Eight persons said either pasture or crop yields had risen since 1966, but only three considered the project was an important reason for the change.

Table 4--Estimated and surveyed land use, Big Creek watershed

Land use	Work plan estimates		1972 survey ^{1/}			
	Flood plain		Flood plain		Upland	
	Before	After	1966	1971	1966	1971
			Acres			
Corn	0	101	8	0	60	43
Pasture	112	216	80	97	751	923
Soybeans	0	0	1	1	278	210
Small grains	0	0	0	0	150	66
Cotton	0	0	0	0	48	30
Other ^{2/}	0	0	0	0	169	172
Woods	<u>407</u>	<u>202</u>	<u>176</u>	<u>167</u>	<u>831</u>	<u>842</u>
Total	519	519	265	265	2,287	2,286

^{1/} Respondents were asked to report land use on the flood plain and upland in 1966, the year before the project was installed, and in 1971.

^{2/} Hay, milo, truck crops, idle land, and conservation reserve.

^{8/} An AUM (animal unit months) is the amount of forage needed to sustain 1 animal unit for 1 month. See also footnote 3 to table 6.

Table 5--Estimated and surveyed land use changes, Big Creek Watershed

Land use	Work plan estimates		1972 survey			
			Flood plain change, 1966-71		Flood plain and upland change, 1966-71	
	Acres	Percent	Acres	Percent	Acres	Percent
Corn	101	--	-8	-100	-25	-63
Pasture	104	93	17	21	189	23
Other crops	0	0	0	0	-167	-26
Woods	-205	-50	-9	-5	2	0

-- = not applicable.

Table 6--Yields on total acres surveyed, Big Creek watershed

Crop <u>1/</u>	Unit	Yield					
		1966		1971		Normally expected	
		Average	Weighted: 2/	Average	Weighted: 2/	Average	Weighted: 2/
Corn	Bu. acre	46	46	42	53	70	70
Soybeans	Do.	24	20	27	24	20	20
Barley/oats	Do.	39	47	44	46	--	--
Pasture	AUM <u>3/</u>	<u>4/</u>	--	<u>5/</u>	--	--	--

-- = not applicable.

1/ Corn--4 responses; soybeans--4 responses; barley--3 responses; pasture--13 responses.

2/ Weighted by number of acres reported in the field survey.

3/ An AUM is the amount of forage needed to sustain 1 animal unit for 1 month. A 1,000 lb. cow with or without calf is 1 AU; a mature bull is 1.25 AU; a yearling is 0.6 AU; a horse is 1.25 AU.

4/ 808 acres grazed by 291 AU.

5/ 980 acres grazed by 525 AU.

Land use can also be intensified by increased application of inputs. Only three respondents said they were applying more fertilizer to their bottom lands; of these, two said the project was an important factor in their decisions. Six persons had bought additional equipment since the project was installed, but only two of these considered the project was a major reason.

The work plan stated that installation of certain land treatment measures was essential to full realization of agricultural benefits. If they were not installed as expected, associated values would be less than projected. Work plan measures included 2,000 linear feet (l.f.) of surface ditches, 12,000 l.f. of mains and laterals, and 10,000 l.f. of tiling. However, only 6,500 l.f. of surface ditches and/or mains and laterals were installed in the benefited area between 1966 and 1972. No tiling was reported.

Nonagricultural Flood Damage Reduction--Flood damage reduction to fences and to nonagricultural installations in Williamston was expected to account for 15 percent of average annual benefits. Evaluation of the performance of the project in this respect was hindered by lack of data on watershed rainfall and runoff. However, it was determined that Big Creek has not flooded since project installation except at the lower end of the improved channel area. None of the five landowners who previously had fence damage reported any problem since project construction. Six of the eight sources of damage reduction in Williamston were covered by interview; no flood damages were reported. Hence, anticipated benefits should have been achieved.

The basis for calculating values over the project's total life is the use made of the protected flood plain, the amount of damageable value, and expected future flood frequency. It now appears that realized values will closely approximate estimated values over the life of the project. At the time of the survey there had been little net change in damageable value in the Williamston flood plain: two buildings, accounting for 40 percent of estimated benefits, were vacant; on the other hand, \$33,000 had been spent since 1966 to improve the town park. This reach of the flood plain is not protected from the 100-year flood event.

Municipal/Industrial Water Supply--The work plan estimated that 27 percent of the total benefits would accrue from the provision of municipal/industrial water supply to Williamston. The survey showed that realized values apparently will exceed those estimated in the work plan. It was expected that reservoir No. 1 would be put into use for water storage on completion of construction, and this was done. Use of the second reservoir was not expected for an additional 10 years; the field survey indicated that it will be put in use earlier than was projected. For example, in 1963, the existing 1.0 mgd. (million gallons per day) water filter plant was expected to meet the town's needs until 1975. However, the average water production figure for 1972 appears to have exceeded this theoretical capacity by some 6 percent. Responding to its greater growth needs, Williamston thus began a \$1.4 million improvement program for its water treatment and distribution system that included construction of a 2.0 mgd. filter plant by mid-1974. In addition, the Big Creek Water and Sewage District was chartered in July 1972. By 1975,

it is expected to serve 1,000-1,200 families in the rapidly expanding residential area west and north of town, as well as 300 families and businesses in nearby West Pelzer.

Incidental Recreation--Incidental recreation benefits, based on a projected 6,900 and 1,050 visitor days of use of reservoirs No. 1 and No. 2, respectively, were expected to account for some 17 percent of average annual project benefits. The survey indicated that the actual level of use was about half this amount. Table 7 summarizes riparian landowners' estimates of the number of people gaining access to the reservoirs via their land, based on the average week in each season of the year. The major activities identified were fishing and swimming (table 8). Speedboating, water skiing, picnicking, hunting, and sailing were of minor importance.

Table 7--Estimated and surveyed annual reservoir use, Big Creek watershed

Reservoir	Work plan estimates	1972 survey
	<u>Visitor days per year</u>	
1	6,900	2,054
2	<u>1,050</u>	<u>1,755</u>
Total	7,950	3,809

Table 8--Major types of reservoir activities, Big Creek watershed

Activity	Rating <u>1/</u>
Fishing	11
Swimming	15
Boating/skiing	38
Picnicking	45
Hunting	46
Sailing	50

1/ Activities were ranked by 9 respondents from most (1) to least (6) important. The rating is the sum of the numerical ratings. Thus, sailing was ranked no. 2 by one person and no. 6 by eight persons, for a total of 50 points.

Other Benefits--Primary benefits not evaluated in the work plan, but reported by three persons in the survey, included reduction in flood and sediment damage to irrigation pumps and to springs used for domestic water.

Respondents also reported higher property values on land adjacent to the reservoirs, although this was not a primary work plan purpose. Only 3 of 23 respondents noted a project-induced rise in watershed income; 3 said there had been a drop. In terms of personal income, 5 of the 23 respondents said there had been a project-induced rise. However, two noted small drops because of flooding of summer pasture, and a poorly shaped spoilbank that required substantial personal investment to provide adequate drainage. One person reported a large drop in income because the project had taken more land, without adequate payment, than he understood he granted in the easement.

Most respondents said the project had enhanced the environment in terms of (reservoir) fishing and the beauty of the area (table 9). At the same time, one-third of the respondents commented on the lack of and need for maintaining the project's components in order to avoid reversion to preproject environmental conditions. Persons living on the channeled reaches of Big Creek reported that small game hunting and stream fishing had been harmed by the project.

Table 9--Project impact on the environment, Big Creek watershed

Environmental factor	Respondents' opinions of project impact		
	Helped	No effect	Hurt
		<u>Number</u>	
Hunting	3	13	7
Fishing	14	6	3
Wildlife cover	8	10	5
Soil erosion	6	14	3
Water quality	8	14	1
Fire risk	4	19	0
Beauty	15	4	4

Installation Costs--Installation costs of the original and amended projects were estimated at \$263,310 and \$335,639, respectively. Actual cost was \$429,161. Land easements, an important local cost item, increased substantially--from \$29,045 in the original plan to \$67,285 in actual costs reported.

Operation and Maintenance--Average annual O&M costs have been only a fraction of work plan estimates (table 10). Eight respondents cited a lack of proper maintenance of the channel and of the recreational aspects of the reservoirs. No expenditures have yet been considered necessary on the reservoirs and pipeline for flood control or municipal water supply.

Table 10--Average annual operation and maintenance costs, Big Creek watershed

Structures	Work plan estimates	1972 survey
	<u>Dollars</u>	
Reservoirs and pipeline--2	1,450	0
Channel improvement	2,126	300
Reservoirs for incidental recreation--2	<u>600</u>	<u>0</u>
Total	4,176	300

Other Costs--Although not monetary costs, two cost-related items were noted by respondents. Three respondents criticized the contractor for a poor job of leveling spoil dredged from the creek channel, so that drainage was impaired or farm machinery could not be brought in to cultivate the land or to cut brush.

The second item referred to a responsibility of the local people. Three of the four sponsors interviewed and several residents said the procedures for obtaining easement were unsatisfactory. They said the document's language was confusing to landowners or was misunderstood. Hence, the description or amount of land actually taken for the project did not always correspond with the amount the landowner believed he granted in the easement.

Reasons for Differences between Projected and Actual Performance

Local Objectives and Interest--Actual agricultural output was below that projected. However, a review of planning files suggested this was not surprising, since increased agricultural production did not appear to be an

important local objective. In contrast, realized values from provision of a greater municipal water supply and from flood protection to urban areas were consonant with the high degree of interest shown by one sponsor, the Williamston City Council. The Council wrote in 1959 that "there will be some municipal benefits derived that are nothing short of amazing." It then mentioned the problems of nonagricultural flood damage (to the municipal water plant and homes in the flood plain) and the shortage of water in summer months.

The objectives of the other active sponsor, the Big Creek Water Conservation District, were not clear from the planning files. No particular interest in agricultural flood protection was noted. Only a negative interest was shown for municipal water supply. A 1962 memorandum explained that the members of the District were not interested in obtaining a loan for that purpose.

Recreation was never considered an important discussion topic by either sponsor. A report of a 1962 field trip by local leaders and SCS personnel did conclude, however, that "the priority and value of the project would be greatly enhanced by the addition of recreation as a purpose."

The 1960 Field Examination discussed the difficulty of developing a project with a favorable benefit-cost ratio if the major source of benefit was higher agricultural output on the protected flood plain. The report also stated that the town was "very much interested in making this a multi-purpose project to provide water for municipal use." The conclusion of the aforementioned 1962 field trip was that the primary local objective was to prevent flooding of the municipal water works and the park. Flood protection for agriculture was again given low priority.

However, these objectives as so articulated were not accurately reflected in the formal development of the project work plan. First, the application for planning assistance (made in 1960 by Anderson County Soil Conservation District, the least involved sponsor) described watershed problems only in terms of frequent flooding that has caused the flood plain to go out of row crop production. Planned effects of works of improvement included damage reduction to nonagricultural sources, water supply, and recreation, but the major orientation and purpose was agricultural. Second, the June 1962 Preliminary Investigation assigned 86 percent of tentative benefits to agricultural flood damage reduction, 14 percent to nonagricultural damage reduction, and none to recreation or to municipal water storage. Third, the consequent Work Outline to formulate a work plan had three objectives: (1) Agricultural flood protection; (2) municipal water storage; and (3) application of land treatment measures. Although not a major objective, it was stated that "there will be some incidental floodwater damage reduction benefits to the City."

Planning Survey--The source of local data for agricultural benefit projections was unclear from the planning files. Five interviews were made in the 1960 Field Examination, which concluded that landowners would put the flood plain into pasture, corn, and small grains if it was protected from flooding. However, this conclusion could not be derived from the interview

forms used because the schedules were only partly completed; also, there were no questions relating to the types of landowner response to reduced flood risk.

Census Data and the 1972 Field Survey--It was not clear from the planning files whether planners took into account the socioeconomic setting of either the Big Creek watershed or of the adjacent three county areas. For example, in response to protection of the agricultural flood plain, farmers were expected to expand corn and pasture acreage, improve existing pasture, and install land treatment measures. Such investments would indicate that planners considered the farming economy in the watershed was relatively healthy and responsive. Census data, however, suggest this was not necessarily the case for either the project county or the two adjacent counties.

First, the importance of the farming economy, in terms of farm products sold, was small relative to value added in manufacturing in all three counties from the late 1940's to the early 1960's (table 11). This period preceded most of the project planning.

Table 11--Farm products sold and manufacturing value added, Anderson, Greenville, and Laurens Counties, South Carolina

Item	:	Anderson	:	Greenville	:	Laurens	:	Combined area
	:		:		:		:	
Farm products sold, 1964 (mil. dol. <u>1</u> /)	:	9.1	:	5.3	:	6.0	:	20.4
	:		:		:		:	
Manufacturing value added, 1963 (mil. dol. <u>1</u> /)	:	90.7	:	221.9	:	44.2	:	356.8
	:		:		:		:	
Ratio of farm (1949) to manufacturing (1947)	:	0:08	:	0:02	:	0:10	:	0:05
	:		:		:		:	
Ratio of farm (1964) to manufacturing (1963)	:	0:10	:	0:02	:	0:13	:	0:06
	:		:		:		:	

1/ Expressed in constant dollars (1958 = 100).

Sectoral changes were occurring in the project county that planners might have explicitly considered in estimating benefits and costs. Agricultural employment declined between 1950 and 1960, in both absolute and relative terms. Off-farm employment rose between 1954 and 1959, and the number of farms fell; on the other hand, farm product sales rose. (See table 12, "Before planning" columns.) Finally, all three counties experienced a shift of population from rural to urban areas between 1950 and 1960.

Table 12--Selected characteristics of the agricultural sector, Anderson, Laurens, and Greenville Counties, South Carolina 1/

Characteristic	Unit	Before planning				After planning		
		1950	1954	1959	1960	1964	1969	1970
Agricultural as a share of total employment	Percent	16.9	--	--	6.2	--	--	2.2
Farmers working off the farm 100 days or more a year	Do.	--	37.8	39.8	--	45.2	56.5	--
Farms	Number	--	5,043	3,209	--	2,103	1,605	--
Farm products sold: <u>2/</u>								
Anderson County	\$1,000	--	7,775	9,552	--	9,103	5,828	--
Laurens County	Do.	--	4,876	5,150	--	6,038	5,026	--
Greenville County	Do.	--	4,635	7,497	--	5,347	4,493	--

-- = data not available.

1/ Except for farm products sold, the trends presented showed the same directions of change in Laurens and Greenville as in Anderson.

2/ Expressed in constant dollars (1965 = 100).

Land use changes--expansions in corn and pasture acreage--were the basis for a large portion of expected project benefits. During 1954-59, the years preceding planning, harvested acres of both corn and all cropland in these areas contracted; pasture declined in Anderson but expanded 2.1 percent in the three-county area. In light of such trends, planners were apparently optimistic in their land use projections.

With one exception, each of the aforementioned changes continued during 1964-69, the period roughly corresponding to project operation (tables 12 and 13, "After planning" columns). This exception, farm products sold, declined rather than increased in each county. As a result, the constant value of farm sales was lower in 1969 than in 1954 for both Anderson and Greenville Counties and was only 3 percent greater for Laurens County.

Table 13--Selected land use, Anderson County and three-county area,
South Carolina

Land use	Before planning		After planning	
	1954	1959	1964	1969
	<u>1,000 acres</u>			
Pasture: <u>1/</u>				
Anderson County	127.8	102.8	100.9	<u>2/</u>
Three counties <u>3/</u>	229.5	234.5	248.9	<u>2/</u>
Corn harvested:				
Anderson County	23.0	11.7	6.3	3.9
Three counties	58.1	28.5	19.8	9.2
Cropland harvested:				
Anderson County	131.3	96.9	64.6	42.2
Three counties	284.2	195.6	133.4	86.4

1/ Includes cropland and woodland used for pasture, and other pasture.

2/ Not available for all farms. For commercial farms only, pasture increased from 55,250 acres in 1964 to 56,142 acres in 1969 in Anderson, and from 125,988 acres to 129,055 acres in the three counties. Commercial farms were 86-91 percent of the total number of farms in the three counties during this period.

3/ Anderson, Greenville, and Laurens Counties.

The 1972 field interviews showed that the watershed's agricultural economy was not isolated from these changes of 1964-69. Nineteen of 22 respondents said that farming had declined in importance relative to nonfarm occupations as a source of community income during the 1960's. This change was explained in two general ways. First, farm labor has been bid away by industry, especially textiles, which offers both a better and a more secure income. Several references were made in the interviews to the growth of industry in the city of Greenville and to additional manufacturing employment in Williamston. Second, low agricultural prices combined with costly labor, fertilizer, and machinery have made it increasingly difficult to earn a good living from farming.

The lessening importance of the agricultural sector was also suggested by the sponsors, who noted that the population of the watershed is growing younger as new, nonfarm families move into the rapidly expanding residential area west of town. Older families are not leaving, but their numbers are decreasing from natural attrition. Census data recorded contractions in harvested corn acreage and a small expansion in pasture after project planning; the surveyed area showed the same changes.

These changes in the area's economy are significant because they reflect an environment in which the project must operate. In addition to the reduction in flood risk that was provided, project beneficiaries cited other factors that were important in their decisionmaking. For example, only 3 of the 10 persons who reported a change in land use cited the project as an important factor; but a factor often mentioned was the scarcity of hired help. The shift from corn to soybeans or to beef cattle, both of which require less labor, was attributed to this labor shortage. Two of the six respondents who purchased equipment after project installation cited the project's importance to their decision. But they also reported that the purchase of more land, unrelated to the project, was a deciding factor. Some merely replaced equipment, but not because of the project. Three of eight who reported higher yields cited the project as a major contributing factor. More fertilizer use, improved seed, and additional crop-growing experience were also cited, however. Factors that reportedly inhibited change included a scarce and expensive labor supply, the operator's retirement, lack of time for farming because of off-farm employment, and the additional cost of more intensive inputs not worth the risk of having a poor crop for unexpected reasons.

There was no evidence in the files that planners considered social and economic factors in estimating benefits and costs for water supply and incidental recreation. Such consideration might have been possible. For example, economic expansion in the city of Greenville has been the motivating factor for the planned expansions in Williamston's urban and rural water networks. The sponsors stated that many of the new families in the project area work in the rapidly growing city of Greenville, only 20 miles away. Greenville's growth was underway when the project was being planned. The population of Greenville County expanded 24.8 percent between 1950 and 1960, outpacing all but six counties in the State.

The use of the project's two reservoirs for incidental recreation had been below projected levels. It appears that even with population growth, future use levels will continue to be limited and will possibly be less than projected. Several contributing factors may be mentioned. First, as recognized by planners, State health regulations will continue to restrict public recreational development of the reservoirs in order to protect the water supply. Second, the Saluda Valley Country Club meets much of its members' recreational needs, including swimming. When the Club was planned in 1963, 6 months following work plan approval, it was decided to build the facility without access to the reservoirs. Third, extensive water-based recreation is now provided by nearby Lake Hartwell and the Saluda River. This study did not determine whether the last two factors could have been evaluated by project planners. It was evident from the files, however, that no particular attempt was made to do so. However, such factors may have a strong influence on the use of the reservoirs for recreation.

Operation and Maintenance--Operation and maintenance, a local responsibility, had been below expectations on the pool areas and pipeline. This was reportedly due to lack of need. However, the lower channel--the major source of planned agricultural benefits--needed maintenance but had not received any. The upper channel had been sprayed for brush control once but needed further

attention. The reason cited for inadequate O&M on the channel was lack of sponsor's funds. This may be a valid reason. Nevertheless, lack of O&M expenditure is also consistent with the secondary importance accorded agricultural benefits in planning, and the lessening role of agriculture along Big Creek. Similarly, none of the planned maintenance expenditures for incidental recreation had been made. Several respondents reported the need for policing the reservoir areas to control trash and garbage disposal, noise, and minor property destruction.

Coonfoot Branch Watershed Project

The Coonfoot Branch project area is a 3,752-acre subwatershed of the Pocomoke River (fig. 2). It is located in a rural area of Worcester County, Maryland, some 6 miles from the county seat, Snow Hill (1970 population, 2,189). Although agriculture as a component of the county's economy has shown a relative decline over the past decade, it remains an important activity. Poultry sales represented over three-fourths of total commercial farm sales in 1969.

The prolonged inundation of flat farmland was the major reason for requesting P.L. 566 assistance. Existing drainage channels were inadequate for removal of heavy rainfall. Extensive areas were also affected by seasonal high water tables. Control of this surface and subsurface water was the prime objective of the local people. To this end, a work plan providing a common drainage outlet to the Pocomoke River was developed and approved (1964). Construction of 12.6 miles of improved drainage channels was completed in May 1968.

The sponsors anticipated the project would help the area in several ways. Rapid removal of abnormally high precipitation would reduce crop damage caused by standing water. Landowners could make more efficient use of production inputs, and diversify their farming operations if they chose to. Finally, floodwater damage to roads and bridges would be reduced.

Projected and Actual Performance

Drainage and Flood Damage Reduction--In 1972, 4 years after project installation, land uses in the project area were different in composition from those estimated in the project work plan. Actual costs were below estimates. Although some response to the project (e.g., greater fertilizer application and installation of drainage laterals) was expected after project installation the principal change expected was a decrease in crop damage caused by standing water. Before project installation, farmers withheld little cropland from cultivation. Rather, they merely suffered yield damages when rainfall was abnormally heavy.

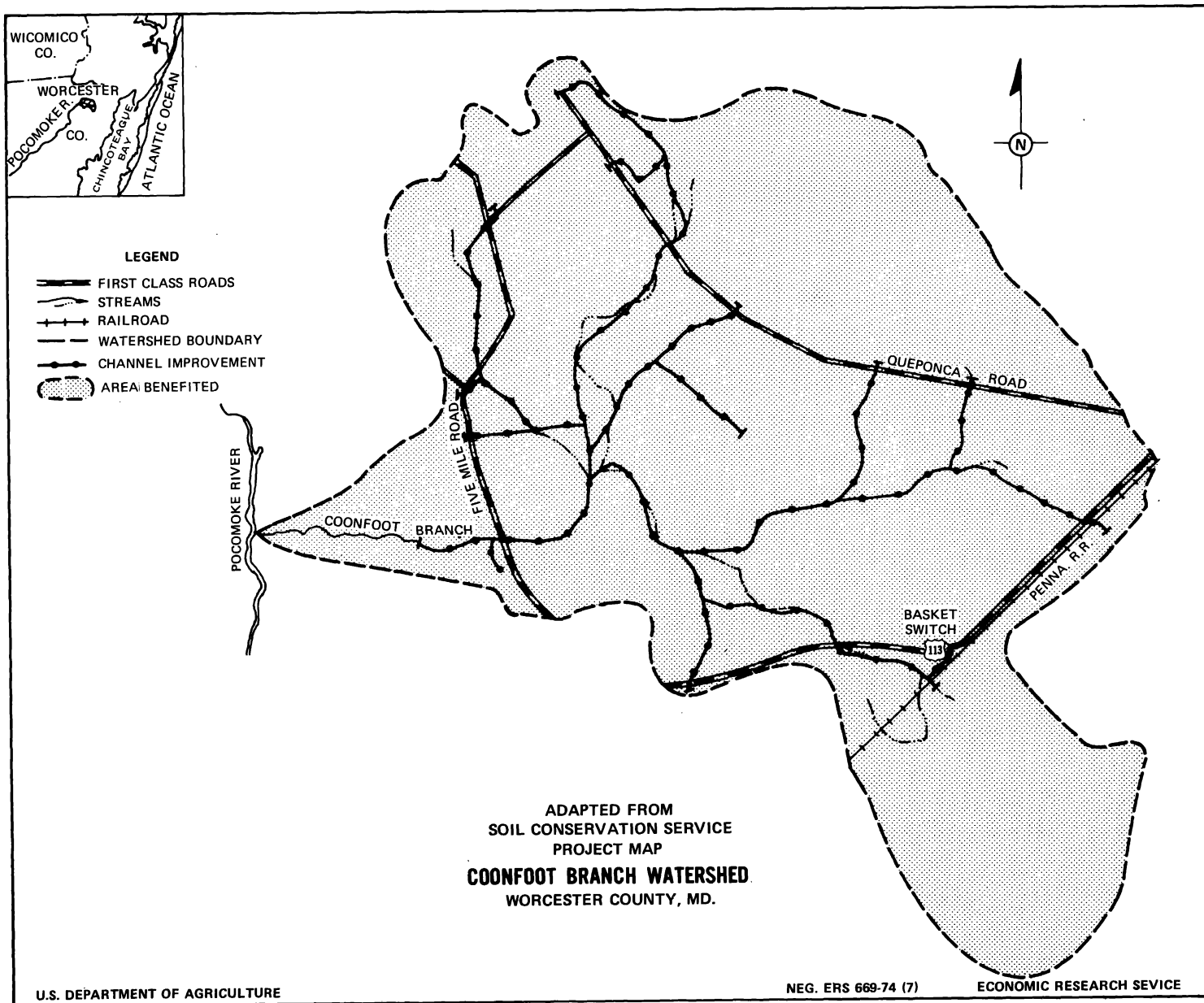


Figure 2

Eleven of 21 persons, including 7 of the 8 full-time farmers interviewed, said the project had improved the drainage on 956 acres 9/ (table 14). Only 214 of the 1,905 acres of cropland surveyed were still considered poorly drained.

The planned purpose of the project was higher yields, and hence higher farm income, on 1,033 poorly drained acres of corn, soybeans, small grains, and pasture. The 1972 field survey of the yield changes between 1967, the year preceding construction, and 1971, the last full crop season, recorded 32 bushels of corn per acre. Although this yield exceeded the 30-bushel increase projected, the percentage increase (39 percent) was much less than the 67 percent estimated in the work plan (table 15). Seven of the 9 persons who reported higher yields said the project was an important contributing factor. The other crops for which higher average yields were projected were not in cultivation at the time of the survey.

The projected increase in average yields also assumed greater use of fertilizer, but only 4 of the 14 respondents reported more intensive application. Eleven respondents said they had purchased new or additional farm equipment since 1967. Three of these said that improved drainage was an important factor in their purchase decisions.

Elimination of yield damages was expected to bring higher incomes. Eighteen persons said community income had risen because of the project; only two felt the project had no effect; and none felt it had caused a drop. When asked about its effect on their personal incomes, the responses were more conservative but still quite favorable: Two persons reported large increases; 7 a small increase; 10, no change; 1, a small drop; and 1, a large drop. Those reporting a drop explained that (1) they were not compensated for salable timber removed from the right-of-way; and (2) one said his preproject drainage was adequate, but he is now taxed for the new ditch. It is noteworthy that eight of the nine respondents experiencing a project-induced increase in income were full-time farmers in 1967, the year preceding installation. Three other farmers reported no change but two of these had retired by 1971.

Surveyed land use differed from work plan estimates. Although no change in land use had been estimated, a substantial change apparently occurred between the time of work plan approval (1964) and the year preceding project construction (1967). Little change was recorded between 1967 and 1971 (table 16); only four persons reported a land use change during this period, and only one of these said the project was an important factor.

9/ In responding, residents defined drainage in terms of the rate of runoff. That is, if rainfall drained slowly from their land, they attributed it to poor drainage. This definition differed from the work plan technical definition of drainage, based on soil structure. Even if a channel system installed on poorly drained land speeds runoffs, the soil remains technically classified as poorly drained.

The local sponsor, the Public Drainage Association, assessed taxes on 1,149 acres of cropland and 823 acres of woodland for drainage benefits from the project. Twenty-one landowners and operators, responsible for 1,074 acres of assessed cropland and 253 acres of assessed woodland, were interviewed.

Table 14--Surveyed drainage conditions, Coonfoot Branch watershed

Drainage	:	1967	:	1971	:	Change, 1967-71
	:		:		:	
	:		:	<u>Acres</u>	:	
Cropland:	:		:		:	
Good	:	1,140	:	1,691	:	607
Poor	:	<u>821</u>	:	<u>214</u>	:	<u>-607</u>
Total	:	1,961	:	1,905	:	--
Woodland:	:		:		:	
Good	:	1,099	:	1,504	:	349
Poor	:	<u>758</u>	:	<u>409</u>	:	<u>-349</u>
Total	:	1,857	:	1,913	:	--
Total land:	:		:		:	
Good	:	2,239	:	3,195	:	956
Poor	:	<u>1,579</u>	:	<u>623</u>	:	<u>-956</u>
Total	:	3,818	:	3,818	:	--

-- = not applicable.

Table 15--Estimated and surveyed crop yields, Coonfoot Branch watershed

Crop yields	Unit	Work plan estimates		Survey, 1972	
		Before installation	After installation	1967	1971 <u>1/</u>
Corn	Bu./acre	45	75	83	115
Changes	Percent	--	+80	--	+32
Changes	Bu./acre	--	+67	--	+39
Soybeans	Do.	15	30	0	0
Small grains	Do.	20	30	<u>2/</u>	<u>2/</u>
Pasture	AUM <u>3/</u>	3	6	<u>2/</u>	<u>2/</u>

-- = not applicable.

1/ Surveyed yields were weighted by the number of acres reported.

2/ Not cultivated in 1967 or 1971.

3/ Animal Unit Months.

Table 16--Estimated and surveyed land use changes, Coonfoot Branch watershed

Land use	Work plan estimates: 1962 <u>1/</u>	1972 survey	
		1967	1971
		<u>Acres</u>	
Corn	639	1,720	1,859
Soybeans	435	186	13
Small grains	139	0	0
Pasture	139	0	0
Woods, other	2,400	1,912	1,946
Total	3,752	3,818	3,818

1/ The work plan estimated no change in land use.

Full realization of project benefits was contingent on the installation of drainage mains and laterals on 387 acres of cropland and pasture; 271 acres were scheduled to be treated by mid-1972. The field study indicated that this goal was substantially exceeded; at least 335 acres had been treated since work plan approval. In conjunction with this work, SCS records show that the field layouts of five farms were extensively redesigned to increase production efficiency.

Other Benefits--A primary benefit reported in the survey but not evaluated for the work plan benefit-cost ratio was reduced flood damage to county roads and farm lanes. Also, improved drainage dried some woodlands sufficiently to permit use of heavy harvesting equipment. Property values were reportedly higher because of the project.

Most respondents said the project had no effect on the specified aspects of the environment (table 17).

Table 17--Project impact on the environment, Coonfoot Branch watershed

Environmental factor	Respondents' opinions of project impact		
	Helped	No effect	Hurt
	<u>Number</u>		
Hunting	5	14	0
Fishing	1	18	0
Wildlife cover	6	13	0
Soil erosion	2	13	4
Water quality	2	16	1
Fire risk	5	14	0
Beauty	7	11	1

Installation Cost--Actual installation cost of the channel improvement was \$109,091, some 12 percent below the work plan projected cost of \$124,200.

Operation and Maintenance--Annual O&M costs have averaged \$360, compared with the (unadjusted) projected cost of \$1,496. Five respondents reported that the channels needed cleaning and the bushes needed cutting.

Other Costs--Although not a monetary cost, one cost-producing concern was raised. Three of the four sponsors and several residents said the channel

contractor did a poor job. He left large tree stumps and did not properly level spoil material. As a result, it was difficult in some places to bring in farm machinery to cultivate the fields or cut brush.

Othello soils are widespread in the watershed. Because of their water-retaining qualities and the lack of slope of the land, lateral ditching is needed to remove excess water. However, woodland owners had not dug these laterals. Seven respondents said drainage is not desirable because standing water is considered beneficial to the loblolly pine--the major forest resource. Consequently, drainage conditions have not changed appreciably in the woodland area.

Reasons for Differences between Projected and Actual Performance

Local Interest--The favorable impact of the Coonfoot project is consistent with the active and widespread interest local people expressed during planning. They installed 3,500 feet of channel work at their own expense that the SCS engineers had not considered necessary for proper functioning of the proposed common drainage outlet. This private expense was incurred in addition to the local share of 21.1 percent of actual structural measure costs. As further evidence of local interest, respondents did not single out any one or two people as being "especially influential in planning," but rather referred to planning as community-wide. Also, landowners are installing land treatment measures more quickly than planned.

Planning Survey--The planning files suggest that local data gathered in a 1963 field survey was the basis for economic benefit calculations. However, the survey's real importance is ambiguous, since (1) the work plan assumptions were not always consistent with the data obtained, and (2) the schedules used were only partly completed. The five operators interviewed in 1963 estimated that average corn yields under preproject conditions were 50, 60, and 62 bushels per acre. The two estimates reported for soybean yields were both 20 bushels. These yields were considerably higher than the work plan base levels of 45 bushels for corn and 15 bushels for soybeans. Had the higher figures been used, the estimated benefits would have been lower. The 1963 survey did not report yields on small grains or pasture, yet both types of land use entered into benefit calculations.

The basis for the size of expected increases in yields was also uncertain since the 1963 survey schedules were not designed to collect such information. However, notations on two schedules indicated that one man estimated his yields would double; the only other estimate was a 50-percent increase. These figures compared with the work plan estimates of a 67-percent increase for corn yields, 100 percent for pasture and soybeans, and 50 percent for small grains.

In addition to improved drainage, respondents in the 1972 survey attributed yield changes--and hence postproject yield levels--to more fertilizer, improved seed, and better herbicides and insecticides. Except for fertilizer, the 1963 survey did not attempt to determine whether landowners would increase their application of these items if adequate drainage was provided. On the other hand, the respondents said they would not alter cropping patterns if adequate drainage was provided, and the work plan did not project any change.

Census Data and the 1972 Field Survey--The project planning files did not indicate that planners considered the effects that socioeconomic trends in the project county might have on the generation of benefits and costs. However, county census data for 1964 and 1969, the period roughly corresponding to project operation, and the 1972 survey suggest that project performance was not isolated from such trends. This was most evident in the differences between projected and actual land use changes.

First, the changes in relative importance of agriculture to the project county and the two adjacent counties were diverse between the late 1940's and early 1960's (table 18). However, the importance of agriculture has been fairly stable in the combined three-county area.

Table 18--Farm products sold and manufacturing value added, Somerset, Wicomico, and Worcester Counties, Maryland

Item	Somerset	Wicomico	Worcester	Combined area
Farm products sold, 1964 (mil. dol. <u>1/</u>)	16.0	28.7	24.1	68.8
Manufacturing value added, 1963 (mil. dol. <u>1/</u>)	6.1	45.7	20.3	72.1
Ratio of farm (1949) to manufacturing (1947)	1:4	0:7	1:9	1:1
Ratio of farm (1964) to manufacturing (1963)	2:6	0:6	1:2	1:0

1/ Expressed in constant dollars (1958 = 100).

In the years preceding project planning, agricultural employment fell relative to other sectors of Worcester County's economy; the number of farms also declined (table 19). Off-farm employment contracted sharply in each county from 1954 to 1959. This decline may have been an aberration, since it was both preceded and followed by significantly higher off-farm employment rates in all three counties.

The basis for project benefits was increased income realized from higher average crop yields. Each crop made a different contribution to the increase. 10/ Census data showed reductions in harvested acres of corn and small grains, and

10/ Net income increase for corn was estimated at \$37.98/acre, for soybeans \$27.13/acre, for small grains \$12.20/acre, and for pasture \$12.00/acre.

in pasture acreage, and an expansion in soybeans in the 5-year period preceding planning (table 20). However, both the 1963 planning survey and the work plan projected no changes in land use.

Table 19--Selected characteristics of the agricultural sector,
Worcester County, Maryland ^{1/}

Characteristic	Unit	Before planning				After planning		
		1950	1954	1959	1960	1964	1969	1970
Agriculture as a share of total employment	Percent	27.7	--	--	18.2	--	--	12.3
Farmers working off the farm 100 days or more a year	Do.	--	25.4	12.3	--	32.1	39.2	--
Farms	Number	--	1,178	1,098	--	824	785	--
Average farm size	Acres	--	134	150	--	170	163	--

-- = data not available

^{1/} Directions of change in 1950-70 were similar in both Somerset and Wicomico Counties as in Worcester.

Corn acreage in Worcester County reversed its earlier trends and expanded after project planning (table 20). Corn acreage in the watershed also expanded. In both the county and the watershed, soybean and small grain acreages contracted. Pasture expanded sharply at the county level; no expansion was shown in the field survey.

From 1964 to 1969, farm employment and the number of farms in Worcester County continued to decline; average farm size increased (table 19). The 1972 field interviews indicated that the watershed was not isolated from these county changes. In commenting on general changes in the watershed economy over the past decade, respondents discussed the shortage of hired labor, rising agricultural production costs, and growing farm size. Unless small operators expand, they are forced out of operation by the shortage of labor and high costs of machinery, fertilizer, and land. Young people were reported leaving because of the high initial capital cost of a successful farm operation. The distribution of major sources of income in 1967 and 1971 for persons interviewed

in the 1972 survey also suggests an aging population and a decline in agricultural employment in the watershed (table 21). Respondents explained that much of the rise in land prices is speculative and is largely attributed to recreational development on the nearby Sinepatuxent Bay.

Table 20--Selected land use, Worcester County and the combined three-county area, Maryland 1/

Land use	Before planning		After planning	
	1954	1959	1964	1969
	<u>1,000 acres</u>			
Corn harvested:				
Worcester	33.3	30.6	35.1	40.3
Three counties	72.9	63.5	68.7	86.0
Soybeans harvested:				
Worcester	21.6	23.6	26.5	20.9
Three counties	55.0	72.9	74.9	61.4
Small grains:				
Worcester	6.2	5.4	3.3	2.4
Three counties	14.6	12.6	10.7	9.3
Pasture:				
Worcester	19.2	10.9	<u>2/</u> 8.5	<u>2/</u> 13.2
Three counties	36.2	23.3	<u>2/</u> 15.7	<u>2/</u> 29.1

1/ Worcester County and the adjacent counties of Somerset and Wicomico.

2/ Commercial farms only.

Respondents also gave several reasons for their shift to corn production: e.g., corn requires relatively little labor, which has become scarce and costly; the market for corn is nearer than that for soybeans; and corn is a less risky crop than soybeans and so provides a surer income.

Table 21--Respondents' sources of income, Coonfoot Branch watershed,

Major source of income	1967	1971	Change
	<u>Number of responses</u>		
Farming	11	8	-3
Nonfarm jobs	5	6	1
Retirement and other	<u>5</u>	<u>7</u>	<u>2</u>
Total	21	21	0

Operation and Maintenance--Actual expenditures for O&M were much below projected levels, reportedly because they were not needed. However, the sponsors interviewed suggested that future costs could be even lower if maintenance was done annually rather than at 4-5 year intervals.

Cedar Creek Watershed Project

The Cedar Creek watershed is in a remote area of Twin Falls County, Idaho ^{11/} (fig. 3). An irrigated zone of about 5,300 acres, known as the Roseworth Tract and Clark Farms, is the locus of most of the economic activity. ^{12/} The nearest towns are Castleford, some 15 miles away with a 1970 population of 172, and Buhl, 25 miles away with a population of 2,975. In 1969, the county economy was primarily agricultural, with crop and livestock sales of equal importance.

Sponsors requested P.L. 566 assistance because of unexpected breakages of the wooden trestle flume that delivered irrigation water to the Tract from the Roseworth Reservoir in the upper watershed. Failure of the system seriously reduced crop yields. Hence, the sponsors' primary objectives were to prevent system failure and to improve both irrigation water supply and irrigation efficiency.







A project was developed and approved in January 1962. It included 1.6 miles of concrete bench flume, two diversion canals, 0.9 mile of canal enlargement, and 31 open-ditch structures. In November 1962, the plan was modified to

^{11/} Small portions also lie in Owyhee County, Idaho, and Elko County, Nevada.

^{12/} The combined area will be referred to only as the Tract.

ADAPTED FROM
SOIL CONSERVATION SERVICE
PROJECT MAP
CEDAR CREEK WATERSHED

OWYHEE & TWIN FALLS COUNTIES,
IDAHO,
AND ELKO FALLS COUNTY,
NEVADA
1962

- LEGEND**
-  STABILIZATION OR SEDIMENT STORAGE STRUCTURE
 -  CANAL
 -  FLUME
 -  WATER SUPPLY RESERVOIR
 -  AREA BENEFITED
 -  ROADS

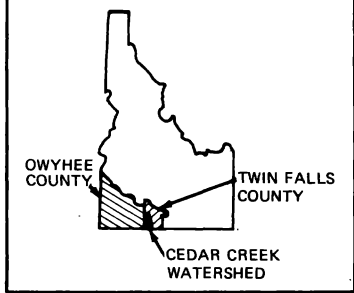
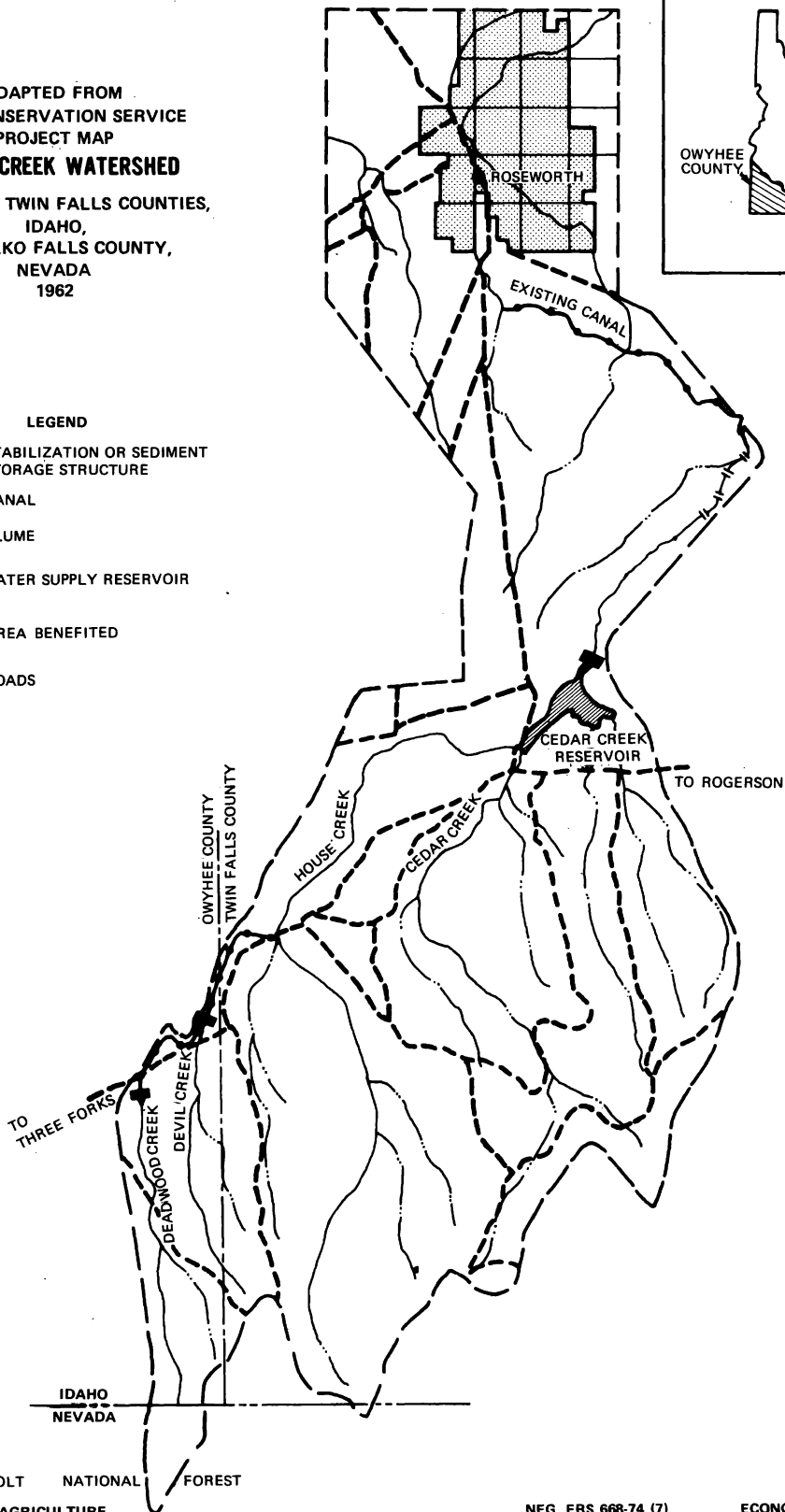


Figure 3

substitute a pipeline for the flume, build a 125-acre-foot regulating reservoir near the Tract, and completely reorganize ranch water delivery systems. The first phase of construction, which included the pipeline, was completed in the fall of 1964. Construction of the amended project was not finished until May 1968.

Projected and Actual Performance

Agricultural Water Management (Irrigation)--In 1972, 7 years after the major first phase of project installation, land use in the project differed in composition from that estimated in the work plan. Actual costs were less than planned. The work plan considered three major sources of benefits: (1) higher net incomes on 4,460 irrigated acres realized by elimination of crop damage; (2) irrigated production on an additional 915 acres interspersed among the 4,460 acres; and (3) reduced system maintenance costs.

(1) Net income--The field survey determined that the new water delivery system had not failed since project installation, and there had been no crop loss. Eight of 10 respondents said that community income had risen because of the project. 13/ The two who cited no change were not landowners but only tenants in 1964, the year selected for preproject comparison. With respect to personal incomes, six respondents attributed a rise to the project; four reported no change.

(2) Additional 915 acres--Neither the work plan nor the 1972 survey identified the additional areas that totaled 915 acres. Full irrigation of this land depended on improvements in water supply, water efficiency, and reliability of water delivery. The survey indicated that the fully irrigated area may have increased by as much as 1,147 acres between 1964 and 1971 (table 22). However, the change may have been as low as 377 acres. 14/ One rancher said the new system enabled him to irrigate one-third more acres. If generalized to all operators, one-third of 4,133 acres irrigated in 1964 would be an increase of 1,377 acres for the Tract, some 20 percent above the upper estimate.

13/ At survey time the irrigated acreage was operated by six landowners and four tenants. The landowners, three tenants, and a former landowner were interviewed.

14/ The total 1971 irrigated acreage surveyed was 1,147 acres above the 1964 acreage. Part of the increase is probably only apparent and not an actual change in acres irrigated. Of the 10 operators interviewed, only 5 worked the same farm over the period. Of these, one reported a decrease of 23 acres in irrigated acreage and one reported an increase of 400 acres. Three respondents involved in the transfer of two farms accounted for an increase of 75 acres. This expansion might be only apparent, since different persons responded for 1964 and 1971. Similarly, a farm worked by two different persons in the 2 years accounted for a decrease of 305 acres irrigated. Finally, although one of these persons also irrigated 1,000 acres of land owned by an absentee owner in 1971, the 1964 operator of this acreage could not be identified. In sum, 377 (400-23) acres should be considered the minimum known increase and 1,147 acres the maximum indicated increase in irrigated acreage.

Table 22--Estimated and surveyed irrigated land use,
Cedar Creek watershed

Land use	Work plan	1972 survey		Work plan	1972 survey	
	estimates:	1964	1971	estimates:	1964	1971
	1958 <u>1/</u>			1958		
		-----Acres-----			-----Percent-----	
Alfalfa hay	446	1,176	1,741	10.0	14.2	33.0
Alfalfa seed	624	50	8	14.0	1.2	0
Wheat	1,204	993	860	27.0	24.0	16.3
Beans	714	633	700	16.0	15.3	13.3
Barley	0	440	720	0	10.6	13.6
Potatoes	446	320	114	10.0	7.7	2.2
Other crops <u>2/</u>	446	443	641	10.0	10.6	12.1
Pasture	<u>580</u>	<u>78</u>	<u>496</u>	<u>13.0</u>	<u>1.9</u>	<u>9.4</u>
Total	4,460	4,133	5,280	100.0	100.0	100.0

1/ The work plan estimated no change in land use.

2/ Peas, oats, mixed grains, idle land, other.

Seven of the nine persons farming in 1972 said the Tract still needed more water in July. However, these same persons said the project had increased the effective water supply. Land treatment measures on the Tract included those designed to insure maximum returns from available water. No comparison is made here between the types and amounts specified in the 1962 work plan, those specified in the November 1962 modification, and those actually installed. This decision was made because the modification did not specify changes in measures to be installed, although a 1968 Progress Report indicated considerable change. The Progress Report also showed that such improvements were largely installed.

The composition of actual benefits differed markedly from work plan estimates. Although no change was expected in cropping patterns, it did occur (table 22). Two persons said the project improvements had been an important factor in their land use changes. Any change would alter values, since each crop's contribution to net income, and hence to project impact, would be different.

Other Benefits--Several primary benefits not evaluated for the work plan benefit-cost ratio were reported in the survey:

- (1) Apart from the elimination of yield damages, one operator reported that his yields were higher because the assured water supply enabled him to irrigate at the most beneficial time.
- (2) Because of the regulating features of the reservoir, an irrigator can order his share of water only 2 hours in advance of use, compared with 2 days required before the project. This has permitted more efficient water use.
- (3) The reservoir is used for stock water in the nonirrigation season. Now that storage is available, it is no longer necessary to draw the water each winter from the distant Roseworth Reservoir. Previously, some 500-1,000 acre-feet of water were lost annually in this transmission.

Provision of a dependable water system has made the Tract more attractive to credit institutions. For example, loans were secured to develop a 3,000-4,000 head feedlot operation and to build several new houses. Also, land values have reportedly risen because of the project.

Respondents were asked whether the project had affected various aspects of the environment. Almost two-thirds reported "no effect" (table 23). A majority felt the beauty of the area had been improved.

Table 23--Project impact on the environment, Cedar Creek watershed

Environmental factor	Respondents' opinions of project impact			
	Helped	No effect	Hurt	
		Number		
Hunting	3	7	0	
Fishing	1	9	0	
Wildlife cover	4	6	0	
Soil erosion	5	5	0	
Water quality	5	5	0	
Fire risk	0	10	0	
Beauty	<u>7</u>	<u>3</u>	<u>0</u>	
Total	25	45	0	

Operation and Maintenance--O&M costs have averaged \$1,120 annually; the average annual projected cost was \$1,680 (long-term prices).

Installation Costs--Actual installation cost of structural measures was \$833,322, compared with \$606,090 and \$787,260 in the original and amended projects, respectively. The project files did not make clear the excess of actual easement costs over estimates. Condemnation proceedings were started to obtain the right-of-way for a diversion dam in the upper watershed. However, it had not been obtained by mid-1968 and the project was closed out without installation of the structure.

Reasons for Differences between Projected and Actual Performance

Local Interest--The favorable impact of the Cedar Creek Project is consonant with the local people's active and sustained interest. Planning files recorded that the local people had been seeking a solution to their water supply problem since 1949. In that year, as well as in 1950 and 1953, formal studies were undertaken and recommendations made for system improvement. An application for planning assistance under P.L. 566 was made in 1956, but local people believed funds would not be forthcoming because of uncertainty regarding qualifications for sponsorship. Considerable local initiative led to resolution of the problem; P.L. 566 was amended in 1961, permitting sponsorship by nonprofit irrigation companies. Local interest was further demonstrated by the sponsors paying 58.9 percent of the actual construction cost of structural measures.

Planning Survey--The 1958 questionnaires did not ask ranchers whether they would make land use changes or whether they expected higher crop yields if the flume was replaced. As a result, the work plan procedure for estimating yield damage reductions and changes in land use could not be documented from these forms. The questionnaires also failed to identify factors, other than a flume break, that might affect future performance. In addition, they were only partly completed.

Census Data and the 1972 Field Survey--The Tract's cropping pattern was not expected to change, with or without the project. This constancy of land use was not entirely compatible with census data for crops harvested in Twin Falls or the adjacent two counties between 1954 and 1959, the project planning period. For example, on table 24, the "Before planning" columns show small acreage decreases for alfalfa hay and dry beans--important crops in both areas.

Contrary to expectations, cropping patterns did change on the Tract after the project was installed. Between 1964 (the year preceding construction) and 1971, strong expansions were reported in alfalfa hay, barley, and irrigated pasture; alfalfa seed acreage disappeared; and wheat and potato acreages decreased sharply. The directions of crop changes, as recorded by the 1972 survey and by 1964 and 1969 census data, were the same in four of five instances (table 25).

Table 24--Selected land use changes, Twin Falls County and three-county area, Idaho-Nevada

Crop harvested:	Twin Falls				Three counties <u>1/</u>			
	Before		After		Before		After	
	planning		planning		planning		planning	
	1954	1959	1964	1969	1954	1959	1964	1969
	<u>Percent</u>							
Alfalfa hay	26.9	25.6	25.8	24.6	28.3	26.9	27.2	25.6
Alfalfa seed	0.6	0.5	0.8	0.5	0.8	1.4	3.3	2.0
Dry beans	30.1	27.7	24.8	n.a.	18.5	15.9	13.6	n.a.
Wheat	15.7	15.8	14.4	11.5	20.6	21.4	16.8	15.3
Mixed grain <u>2/</u>	2.5	2.6	3.5	6.4	6.2	4.2	6.1	10.7
Potatoes	4.7	4.2	2.7	3.4	4.2	5.7	6.4	6.1
Other	<u>19.5</u>	<u>23.6</u>	<u>28.0</u>	<u>53.6</u>	<u>21.4</u>	<u>24.5</u>	<u>26.6</u>	<u>40.3</u>
Total cropland: harvested	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

1/ Twin Falls and the adjacent counties of Cassia and Owyhee. Data for 1954-59 are for all farms; data for 1964-69 are for commercial farms only.

2/ Barley, oats, rye.

Table 25--Land use changes during project operation, Cedar Creek watershed

Land use	Direction of change	
	Survey:	Census:
	1964-71	1964-69 <u>1/</u>
Alfalfa hay	+	-
Alfalfa seed	-	-
Mixed grains	+	+
Wheat	-	-
Potatoes	-	-

1/ Cassia, Owyhee, and Twin Falls Counties.

The surveyed expansions in alfalfa hay and pasture were reportedly due to greater livestock production. This in turn resulted from the newly dependable water supply, new sources of credit, high beef prices, and low labor requirements. Hay is used for feed and also as a ground conditioner for land planted to beans and mixed grains. Barley acreage expanded in response to the good contract price offered by a new purchaser on the Tract. The wheat acreage decrease was partly attributed to barley expansion, since barley acreage could be used to meet one's wheat acreage allotment. The decline in potatoes was attributed to several factors: the low contract price offered by the only buyer in the area; low-cost competition; high water and labor requirements; and costly transportation. Bean acreage expanded slightly; this crop uses relatively small amounts of labor and water, and is easy to transport.

Census data indicate that the growing scarcity of labor and its effect on cropping patterns could have been explicitly recognized by project planners. In Twin Falls, as well as the adjacent counties, rural areas lost population to urban centers between 1950 and 1960, the agricultural sector became relatively less important as a source of employment, numbers of farms and farmers decreased, and more farmers reported off-farm employment. ^{15/} Each of these "Before planning" trends continued "After planning" (table 26).

Table 26--Selected socioeconomic characteristics,
Twin Falls County, Idaho

Characteristic	Unit	Before planning				After planning			
		1950	1954	1959	1960	1964	1969	1970	
Urban population	:Percent:	50.0	--	--	55.4	--	--	60.0	
Employment in agriculture	: Do. :	29.7	--	--	23.4	--	--	16.7	
Farms	:Number :	--	2,406	2,241	--	1,907	1,745	--	
All farm products sold ^{1/}	:\$1,000 :	--	33,720	44,854	--	39,286	40,299	--	
Farmers working off the farm 100 days or more a year	:Percent:	--	12.4	18.8	--	19.9	25.6	--	

-- = data not available

^{1/} Expressed in constant dollars (1965 = 100).

^{15/} Owyhee County remained 100 percent rural between 1950 and 1970.

Operation and Maintenance--Average annual expenditures for O&M have been less than work plan estimates, although all needed work was performed.

Peck's Run Watershed Project

The Peck's Run watershed drains 8,210 acres, 92 percent in Upshur County and 8 percent in Barbour County, West Virginia (fig. 4). The communities of Hodgesville and Teter, with 1960 population of 330 and 35, respectively, are within the watershed. The main trading center is Buckhannon, 6 miles to the south, with a 1960 population of 8,586. Coal mining and livestock production were major sources of income in the watershed in the early 1960's. In 1962, Upshur was designated an area redevelopment county. Its economic decline was attributed to several factors, including the closing of many small coal mines, the mechanization of others, and low prices for lumber and agricultural products. 16/

The watershed had several water-related needs for which P.L. 566 assistance was requested. Because of annual flooding, only a small portion of the flood plain was in agricultural production and there was substantial periodic damage to homes, businesses, roads, and bridges. Considering these problems, the sponsors agreed on two objectives:

- (1) Keeping the 100-year flood event below all first-floor levels in Hodgesville, and for a distance of 1,000 feet below the town.
- (2) Providing 3-year flood event protection to the agricultural flood plain below Hodgesville.

A work plan, developed and approved in 1963, included 6.0 miles of stream channel improvement. Nearly all channel work was done in 1966; construction was completed in June 1968.

Projected and Actual Performance

In 1972, 5 years after project installation, agricultural land use changes were smaller than expected, nonagricultural land use changes were similar to those expected, and O&M costs were less than work plan projections.

Agricultural Flood Damage Reduction--In response to reduced flooding, landowners were expected to restore their flood plain lands to levels of former productivity. Expected changes were increases of 62 acres of hay and 35 acres of corn, and a decrease of 40 acres of pasture and 57 acres of woods (table 27). These changes were the source for 17 percent of projected benefits. Over 95 percent of the land use changes were expected to occur in Reaches III-IV below Hodgesville. (See fig. 4.)

16/ An Overall Economic Development Program for Upshur County, West Virginia, Upshur County Development Committee, Buckhannon, pp. 11, 22, 1962.

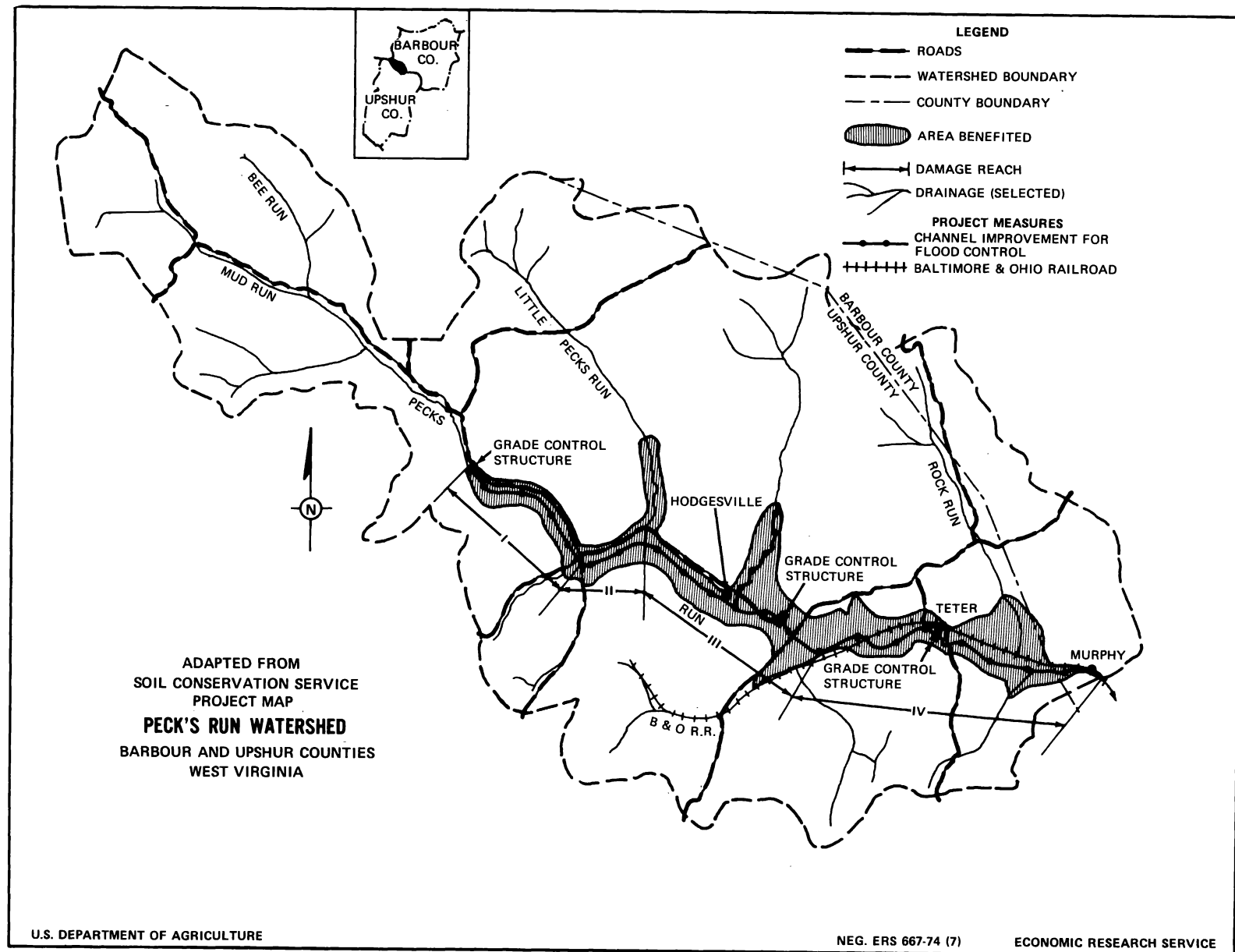


Figure 4

Table 27--Estimated and surveyed flood plain use, Peck's Run watershed

Land use	Work plan estimates			1972 survey <u>1/</u>		
	Before	After	Change	1965	1971	Change
	<u>Acres</u>					
Corn	10	45	35	7	0	-7
Hay	47	109	62	170	157	-13
Pasture	58	18	-40	10	10	0
Other <u>2/</u>	<u>189</u>	<u>132</u>	<u>-57</u>	<u>24</u>	<u>44</u>	<u>20</u>
Total	304	304	0	211	211	0

1/ Respondents were asked to report for 1965, the year preceding construction, and for 1971. The surveyed flood plain was land that flooded at least once or twice yearly.

2/ Woods, idle land, miscellaneous.

The field survey showed that flood plain land use changes were the opposite of those expected: hay and corn acreages contracted; pasture acreage did not change; and other crop acreages increased. 17/ Six persons reported a change in land use; three of these, all residing in Reaches III-IV, said the project was important to their decisions.

It was also expected that hay and pasture yields would triple and corn yields would reach 50 or 70 bushels/acre (table 28). The survey was inconclusive on actual change, since (1) respondents were unable to separate yields on bottom land and upland, and (2) hay yields were not reported entirely in tons/acre, as expressed in the work plan, but also in unweighed bales/acre, unbound stacks, and also tons/acre. Six persons said yields for one or more crops had risen since 1965. Four persons, three residing in Reaches III-IV, said the project was an important reason for the change.

Higher yields could also have resulted from increased fertilizer use. Two persons reported increased use; both cited the importance of the project to their decisions.

The full realization of agricultural benefits partly depended on installation of land treatment measures in the flood plain. These improvements had not reached expectations at the time of the survey (table 29).

17/ Hay acreage in the surveyed upland also declined, from 227 acres in 1965 to 152 acres in 1971; pasture contracted from 958 to 844 acres. No corn or other crops were cultivated in either year.

Table 28--Estimated and surveyed crop yield changes,
Peck's Run watershed 1/

Crop	Unit	Work plan estimates		1972 surveyed change
		Before	After	
		installation	installation	
Corn	Bu/acre	0	50-70	<u>Percent</u> <u>2/</u>
Hay	Tons/acre	1	3	+43 to +84
Pasture	AUM/acre	1	4.4	<u>2/</u> -5.6 to -3.9
	<u>3/</u>			

1/ Work plan changes are for flood plain only; surveyed changes combine flood plain and upland.

2/ None cultivated.

3/ In 1965, 450 AU grazed on 968 acres; in 1971, 279 AU grazed on 854 acres.

Table 29--Estimated and surveyed flood plain improvements,
Peck's Run watershed

Improvement	Unit	Work plan estimates	1972 survey
Wood clearing	Acres	6	0
Tiling	Linear feet	63,000	2,450
Liming	Acres	45	97

Nonagricultural Flood Damage Reduction--Decreased nonagricultural flood damage accounted for 83 percent of planned benefits. Evaluation of performance was hindered by lack of rainfall data for the benefited area. However, the survey did determine there had been no flooding since project installation. Six persons said Hodgesville would have been under water in June 1972 if the channel had not been improved. Hence, it appears that performance has equaled work plan estimates.

As discussed on page 18 of the Big Creek project, future impacts of the Peck's Run project will depend on the value of damageable property in the protected area and the frequency of flooding. Two areas of the Peck's Run flood plain were evaluated in this study.

- (1) In the area protected from the 100-year flood event (the expected source of 91 percent of work plan benefits), there was some intensification of land use and some increase in damageable property values. Although three businesses ceased operations, two homes were remodeled and two others, along with three sheds and an elementary school, were constructed after the project was approved. Considering the high level of flood protection, increased production of goods and services from these improvements would probably be greater than increased flood damages during the useful life of the project.
- (2) In the area given 3-year protection (the source of 9 percent of this benefit), there was substantial intensification of land use. Four house trailers were installed on land formerly in low-producing meadow. Given the low degree of flood protection and the consequent expectation of recurring flooding, the value of using land for residences will probably be less than flood damages incurred during the useful life of the channel.

Because of the percent distribution of expected benefits to the two areas, it appears that benefits from the total project will exceed work plan estimates.

Other Benefits--Two primary benefits not evaluated in the work plan were reported in the survey:

- (1) Straightening of the meandering, shallow channel has increased the amount of tillable land.
- (2) Straightening has also permitted the squaring of odd-shaped fields, which has reduced the time needed to cut the hay crop.

Ten of 24 respondents said watershed income has risen because of the project; 7 were from Reaches III-IV. Eight persons reported a rise in personal income; four were from Reaches III-IV.

A majority of the respondents felt that the project had no effect on the specified aspects of the environment (table 30). However, beauty, water quality, and soil erosion were most often considered enhanced.

Installation Cost--Actual installation cost was \$303,191, compared with a projected cost of \$266,200. One item, easements--an important local cost item--increased from an estimated \$19,600 to \$28,183.

Operation and Maintenance--O&M was projected at \$3,900 annually; actual cost has averaged \$1,219 annually. Work was needed but none was performed in 1971 or 1972.

Other Costs--Although not monetary costs, several points were raised by respondents that were considered cost producing. The contractor was cited by 11 persons for doing an inadequate job of backfilling, for spreading spoil so as to worsen drainage or at least not improve it, or for applying insufficient lime to the dredged materials. Nine respondents said the procedure for

obtaining easements, a local responsibility, was inequitable since the sponsors purchased several easements for relatively large sums after most of the land had been donated at the sponsors' request. Aside from this source of ill feeling, three respondents, not understanding the conditions of the easement, said the contractor should have replaced the farm bridges that were removed for straightening or otherwise improving the channel.

Table 30--Project impact on the environment, Peck's Run watershed

Environmental factor	Respondents' opinions of project impact		
	Helped	No effect	Hurt
		<u>Number</u>	
Hunting	2	20	0
Fishing	2	16	4
Wildlife cover	4	15	3
Soil erosion	13	9	0
Water quality	13	9	0
Fire risk	3	19	0
Beauty	19	1	2

Reasons for Differences between Projected and Actual Performance

Local Interest--In contrast to the other projects studied, the Peck's Run project files contained little correspondence indicating the nature or intensity of local interest. However, two events suggested limited interest: (1) The local people decided not to organize a formal sponsoring organization within the watershed. Hence, the project sponsors, the Upshur County Court and the Tygarts Valley Soil Conservation District, were county rather than locally based; and (2) two-thirds of the residents identified just one person as "especially influential in planning." This contrasts, for example, with the Coonfoot Branch project, where 11 people were so identified and only 1 person was cited as many as 5 times.

The formal application for planning assistance listed nine objectives: reduction of flood damage, provision of recreation, regulation of water flow, restoration of top soil, reduction of soil erosion, wildlife conservation, better forest management, enhancement of land values, and elimination of stagnant water.

Planning Survey--Actual agricultural performance was below work plan estimates; nonagricultural performance closely approximated estimates. This performance was consistent with the relative attention accorded each project purpose in the work plan formulation.

Nearly 70 interviews were carried out during planning to determine the extent of nonagricultural flooding; but since the questionnaires used were oriented toward this problem, they were not as effective in diagnosing the extent and importance of flooding to agricultural lands. Hence, the basis for land use adjustments, yield changes, and crop responses to structural improvements could not be determined from these interviews.

Census Data and the 1972 Field Survey--The planning files did not indicate whether the socioeconomic setting of the project area was considered. For example, landowners were expected to make land use changes and install drainage tiles in response to flood protection. Such expectations would indicate that planners considered the watershed farming economy was relatively healthy and would respond to reduced flood risk. However, census data suggest this was not the case. First, the relative importance of farming to Upshur County, in terms of farm products sold, declined sharply from the late 1940's to the early 1960's (table 31).

Table 31--Farm products sold and manufacturing value added,
Barbour, Lewis and Upshur Counties, West Virginia

Item	:	Barbour	:	Lewis	:	Upshur
Farm products sold, 1964 (mil. dol. <u>1/</u>):	:	1.2	:	1.5	:	1.2
Manufacturing value added, 1963 (mil. dol. <u>1/</u>)	:	0.9	:	5.8	:	1.4
Ratio of farm (1949) to manufacturing value (1947)	:	6:1	:	0:6	:	2:1
Ratio of farm (1964) to manufacturing value (1963)	:	1:3	:	0:3	:	0:9

1/ Expressed in constant dollars (1958 = 100).

Sectoral changes occurred in the 1950's that planners might have explicitly considered in estimating benefits and costs (table 32). Agricultural employment decreased between 1950 and 1960. Off-farm employment increased between 1954 and 1959, and the number of farms decreased. Farm product sales rose over the 5-year period, but this was entirely due to a 26-percent jump in livestock sales, the major component of farm sales.

Table 32--Selected characteristics of the agricultural sector,
Upshur County, West Virginia

Characteristic	Unit	Before planning				After planning		
		1950	1954	1959	1960	1964	1969	1970
Agricultural as a share of total employment	Percent	22.0	--	--	9.4	--	--	2.6
Farmers working off the farm 100 days or more per year	Do.	--	43	46	--	48	47	--
Farms	Number	--	1,648	1,167	--	917	574	--
Farm products sold <u>1/</u> :\$1,000		--	1,213	1,454	--	1,389	1,248	--

-- = data not available.

1/ Expressed in constant dollars (1965 = 100).

Land use changes (more corn and hay acreage; less pasture) were the basis for agricultural benefits. In table 33, "Before planning" data show that these expectations were not necessarily consistent with changes in either Upshur or the Upshur-Barbour area.

The "After planning" data in tables 32 and 33 show a continuation of the declining trends of earlier years. In 1969, sector employment, farm numbers, and farm sales were below 1959 levels; off-farm employment was nearly the same; hay acreage harvested had contracted; and corn acreage was about the same.

On the other hand, the nonagricultural economy, although depressed in the 1950's and early 1960's, gained strength during the 1960's as a whole. After declining in the 1950's county population began to increase again; Buckhannon had a 10-percent rise over the decade. Median county income rose 91 percent compared with only 62 percent for the State.

Survey data show that the watershed economy was not isolated from these changes. Nine of 22 respondents said farming had declined in importance as a source of community income since the early 1960's; 10 reported no change; only 3, referring to livestock production, said farming was more important. Those citing a decline referred to the shortage and high cost of labor, caused by the resurgence in mining and the location of new industry in Buckhannon. In commenting on factors that affected their response (or lack of same) to the project, residents discussed the shortage and high cost of farm labor; greater profitability in stripmining coal; scarcity of flat, tillable land that limits farms to an uneconomic size; poor health of the operator; and the part-time nature of farming.

Table 33--Selected land use changes, Upshur County and two-county area,
West Virginia 1/

Land use	Before planning		After planning	
	1954	1959	1964	1969
	<u>1,000 acres</u>			
Hay crops harvested:				
Upshur	18.1	16.7	14.6	10.6
Two counties	39.7	35.6	32.5	25.6
Corn harvested:				
Upshur	2.3	0.8	0.5	0.6
Two counties	5.3	2.2	1.2	1.0
Pasture:				
Upshur	82.2	74.3	70.3	<u>2/</u>
Two counties	180.1	160.5	132.7	<u>2/</u>

1/ Upshur and Barbour Counties.

2/ Available for commercial farms only. In 1964 and 1969, these farms represented only 29 percent and 47 percent, respectively, of total land in farms. For these farms, pasture expanded in both areas between 1964 and 1969.

Operation and Maintenance--O&M was done annually for 3 years after project installation, but because of financial problems the Upshur County Court, the responsible sponsor, was not able to complete needed work in 1971 and 1972. This lapse in O&M expenditures may be significant to the performance of the channel work if it indicates future behavior. Planning correspondence between SCS personnel recorded substantial concern regarding the useful life of the channel. A 1963 memo stated that useful life would normally not exceed 50 years (rather than the 100 years adopted), even if it received periodic reconstruction in addition to normal O&M attention.

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